Advancing Boreal Forest Archaeology: Intrasite Spatial Analysis of the Eaglenest Portage Site

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ABSTRACT

This thesis presents the results of an intrasite spatial analysis study of an archaeological assemblage from the Eaglenest Portage site in the Birch Mountains of northern Alberta. In this region, many sites consist of a seemingly random accumulation of stratigraphically mixed artifacts created through repeated occupations. Challenges arise for archaeologists who work in the region, due in part to physical and biological processes that move artifacts from where they were initially deposited, resulting in a general lack of stratified sites. These challenges make it difficult to understand both the vertical and horizontal spatial relationships between artifacts. Research in northern Alberta has primarily been conducted by consulting firms to make way for new industrial developments. Due to the perceived mixing of artifact assemblages, consulting archaeologists do not map all artifacts found in situ; instead, it is common to shovel-shave excavation units in arbitrary levels. Ives (1985) attempted to overcome the challenges of the boreal forest environment by collecting three-point provenience measurements (north, east, and depth below datum measurements) for each artifact collected from the Eaglenest Portage site and subsequently conducting a spatial study on the distribution of finished artifacts. The research presented in this thesis shows that carefully controlled excavations, with emphasis on three-point provenience measurements and spatial analysis (surface interpolation, nearest neighbour analysis, kernel density, k-means, and hot spot analysis) of an entire artifact assemblage, offer an objective method by which to identify temporally related clusters of artifacts and potential features that otherwise would be missed using the typical excavation practices in place today. A total of 25 clusters were identified in the four blocks that were excavated at the Eaglenest Portage site. The clusters allowed a range of discrete activities and potential features to be identified. This study and the study of Ives (1985) before it emphasize the importance of three-point provenience data in the interpretation of sites with limited stratigraphy. With this in mind, archaeologists and archaeological regulatory bodies should rethink what are deemed to be adequate excavation practices in the boreal forest.

ACKNOWLEDGMENTS

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This thesis was inspired by a project that was undertaken at the University of Alberta with artifacts collected from Ahai Mneh (FiPp-33). I would like to again express my gratitude to Dr. John W. Ives for allowing me to be apart of that project. I would also like to thank Aileen Reilly, Peter Stewart, and Gabriel Yanicki who all, in one way or another, inspired the work that is seen in this thesis.

I began my career in archaeology with Stantec Consulting Ltd., and since that time I have worked at a number of different consulting firms, with many permit holders and field assistants. These brilliant friends and colleagues (of which there are too many to name) have inspired me throughout the many years. There is no way to express how much it has meant to me to be able to learn from and work aside such a talented group of people. Special mention must go to Laura Nuttall who recognized and fostered my passion for archaeology and encouraged and helped me to apply for my graduate degree. I hope one day to be half the archaeologist she is. I am also particularly thankful that in my first two years as an archaeologist I had the opportunity to work with Jean-Paul Foster, who not only taught me how to find sites, but who was also gracious enough to demonstrate the proper way to sink an Argo. Special thanks must go to Kyle Belanger who has greatly enhanced my ability to interpret lithic technologies and for always being available to discuss anything archaeological related with me. Thank you to Margarita De Guzman and Circle Consulting for keeping me employed throughout much of the duration of my writing process.

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CHAPTER 1: INTRODUCTION

1.1 Introduction to the Research Problem

Archaeological studies in northeastern Alberta are primarily driven by industry. Each year, archaeological consulting firms excavate sites in order to make way for new industrial developments, gathering data on a vast scale. Yet the nature of cultural change reflected by the archaeological record of the Alberta boreal forest region is still poorly understood. This problem reflects the issues in analyzing and synthesizing such large volumes of data. The issue is compounded by the fact that the area lacks radiocarbon dates and definable stratigraphy (Section 1.2). This is challenging, as in other parts of the world, stratigraphy and radiocarbon dates are the basis for defining and understanding archaeological change.

The stratigraphic issues at boreal forest sites are in large part due to a number of natural processes that act to modify the archaeological record in this region. Processes such as tree throws, root growth, and rodent burrows move artifacts from where they were initially located and make it difficult to understand both the vertical and horizontal spatial relationships between artifacts (Schiffer 1987; Wood and Johnson 1978). These issues coupled with the lack of sediment deposition can hinder the analysis of archaeological sites in the region. This is especially true of multicomponent sites where the relationship between any two artifacts can be called into question. Given these conditions, archaeologists who work in the region are faced with three fundamental questions:

1. To what extent do natural processes (tree throws, rodent burrows, frost-heave, etc.) affect the formation of the archaeological record?
2. Despite the problems of stratigraphy and bioturbation can spatial clusters of artifacts be identified and are these spatial clusters temporally related?
3. What excavation and data recording methods would be best suited for obtaining the data necessary to identify distinct spatial clusters of artifacts?

The research presented in this thesis documents how carefully controlled excavations, with emphasis on three-point provenience measurements and spatial analysis, can offer an objective method by which to deal with the stratigraphic issues of the boreal forest. To test this hypothesis, a spatial analytical study of the Eaglenest Portage archaeological site (HkPa-4) will be used. This site was chosen because in spite of all the data that have been generated in the region, relatively little has been collected in a manner that allows for a detailed spatial analysis.

However, the nature of the investigations at the Eaglenest Portage site led to the collection of three-point provenience data for each artifact found in situ (Ives 1977, 1985). Additionally, despite the general lack of stratigraphy and potential for bioturbation, previous research at Eaglenest Portage has shown that discrete horizontal spatial clusters of artifacts could still be defined (Ives 1985). Through the application of Geographic Information System (GIS) procedures, this thesis presents a new, detailed spatial analysis of the site, including both horizontal and vertical artifact distributions, and demonstrates that this approach provides invaluable information regarding the spatial distribution of artifacts and features in a boreal forest environment.

1.2 Research Objective

Archaeologists working in the boreal forest are presented with a number of challenges. For example, most sites exist in conditions in which there is a slow rate of sediment deposition; they therefore lack any discernable stratigraphy. Furthermore, the acidic nature of the region's soils can strip away organic materials such as tools made of bone, antler, hide and wood. Reliance upon such materials is well known in ethnographic literature (Goddard 1916; Osgood 1940; Tanner 1979) but is rarely reflected in an archaeological context. These conditions have led to a situation in which some archaeologists have formed a negative impression of the region. In fact, Le Blanc writes,

> "I have heard comments from colleagues who work elsewhere in North America that there are no large sites in the boreal forest, particularly stratified ones; no hearths survive; and even statements asserting that nobody lived in the boreal forest because they either passed through it from one region to another, presumably better area to live, or only visited it for short-term hunting expeditions!" (Le Blanc 2004:133-134).

As Le Blanc points out, these misconceptions can easily be dismissed with a preliminary review of the archaeological record (Le Blanc 2004:134). Sites in the boreal forest are often large (e.g., Ives 1985; Roskowski 2015; Saxberg 2007; Sims 1976a; Syncrude 1974), and in rare instances have proven to be deeply stratified (e.g., Conaty 1978; Millar 1983; Stevenson 1985, 1986). Additionally, although hearths and other features are often times unidentifiable, they do exist (e.g., Ives 1986; Janes 1989; Le Blanc and Ives 1986; Le Blanc 2004), and even when they are not easily recognizable during excavation, their former presence can sometimes be inferred when artifact distribution patterns are recorded in sufficient detail (Sergant et al. 2006; Waguespack and Surovell 2014; see also Chapter 5 Section 5.3.6.1). Nonetheless, in order to deal with the lack of stratified deposits and radiocarbon dates we need to find innovative ways to draw more data from this rapidly disappearing archaeological record.

Thus, the primary objective of this research is to determine an adequate method for dealing with the stratigraphic problems presented by boreal forest environments. The nature of archaeological resources makes them particularly vulnerable to loss and destruction by expanding industrial activity. Currently, archaeological research in northeastern Alberta is predominately conducted by archaeological consulting firms. Due to time and budget constraints, consulting archaeologists do not map all artifacts found in situ; instead, it is common to shovel-shave excavation units in 10-cm arbitrary levels. While the data collected using these methods can contribute to answering many important research questions, it is insufficient for a detailed spatial analysis of a single archaeological site. The aim of this research is to determine if more information could be extrapolated through the spatial analysis of an artifact assemblage that has been collected using three-point provenience measurements than was previously thought possible. This research will hopefully encourage archaeologists and archaeological regulatory bodies to rethink what are deemed to be adequate excavation practices in boreal forest environments. As industry continues to advance into the region, archaeological sites are continually being impacted. With the existing standards in place, archaeologists who wish to tackle the spatial issues of the boreal forest are severely restricted by the quality of the data that are currently available. This research presents an objective method for dealing with these spatial concerns and if these methods are incorporated into future excavations, we will be able to create an improved understanding of the pre-contact groups that inhabited the boreal forest. This can help improve our understanding of the past not only in Alberta, but also in British Columbia, Saskatchewan, Manitoba, Northwest Territories, and anywhere else where bioturbation and a lack of sediment deposition can obstruct the analysis of archaeological sites.

1.3 Thesis Organization

This thesis is divided into eight chapters. Chapter one introduces the research problem and outlines the objectives and organization of the thesis. Chapter two provides a brief introduction to the environmental background of the study region. Chapter three analyses previous work that has been conducted in the study region and adjacent areas. Chapter four gives an outline of the culture history of northeastern Alberta and adjacent regions. Chapter five briefly discusses the history of spatial analysis and gives a brief description of the bioturbation processes that can occur in the boreal forest environment. This chapter also discusses, in detail, the statistical methods that were used for this study. Chapter six provides the results of the statistical tests that were conducted on the data. Chapter seven takes an in-depth look at the results and chapter eight discusses the validity of the methods used and provides suggestions for future researchers who work in northern Alberta or anywhere else where bioturbation and a lack of sediment deposition hinder the analysis of archaeological sites.

CHAPTER 2: NATURAL ENVIRONMENT

2.1 Introduction

Studies of the natural environment can be vital interpretive tools, especially in regions with poor organic preservation (McCulloch 2015:8; Saxberg and Reeves 2003; Bouchert-Bert 2002). These studies allow archaeologists to hypothesize how the environment helped to shape the cultural development of the area. Groups that inhabited the boreal forest would have relied upon the environment for food, clothing, and shelter. Additionally, the environment facilitated or obstructed the movement of ideas, traditions, and cultures (Oetelaar and Meyer 2006). The environment also placed limitations on groups by dictating which resources were available and by determining where individuals could or could not travel. Knowledge of past environmental conditions allows for a better understanding of the restraints and resources that would have been available to the groups who occupied this region. Therefore, to comprehend the prehistory of the Eaglenest Portage study area, it is important to consider how the natural environment changed and developed throughout history. This chapter will provide a detailed overview of some of the important climatic and environmental conditions of the region over time.

2.2 Study Area: The Eaglenest Portage Site (HkPa-4)

The Birch Mountains are an erosional remnant of upper Cretaceous bedrock that rises over 400 m above the surrounding boreal plains (Allen and Johnson 2007:1; Timoney 2013:505). The Eaglenest Portage site (Figure 2.1) is located in the northeast corner of the central Birch Mountain Depression and is considered to be part of the Upper Boreal Highlands natural sub-region (Natural Regions Committee 2006:145). The Upper Boreal Highlands is a physiographic subdivision of the boreal forest, which is characterized by unique vegetation, climate, and elevation (Natural Regions Committee 2006:1; Section 2.5).

The site is situated on a large terrace above a drainage linking Eaglenest and Clear Lakes (Figure 2.1) and consists of a complex overlay of artifacts that likely represent a repeated series of occupations (Ives 1977; 1985; 1993; 2017). The strategic location of the site, close to many subsistence resources, likely attracted groups into the region throughout pre-contact times.

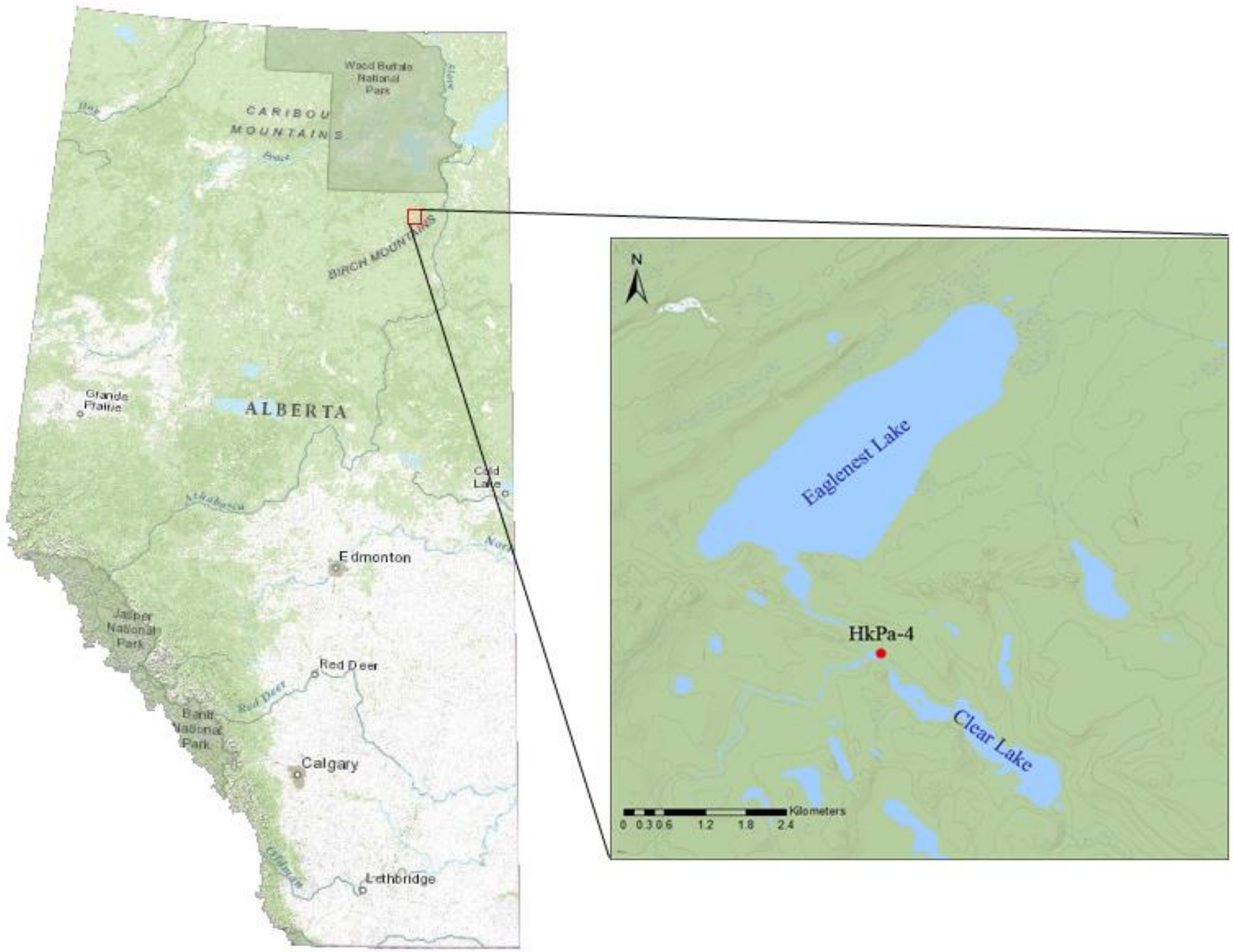


Figure 2.1 Map showing the location of the Eaglenest Portage site (HkPa-4).

Figure 2.2 Aerial view of the Eaglenest Portage site looking north (Photograph courtesy Royal Alberta Museum).

2.3 Deglaciation of Northern Alberta

Evolution of the modern boreal forest began near the end of the Late Pleistocene glaciation, with the north-eastward retreat of the Laurentide Ice Sheet (Figure 2.3). Pollen studies from the Birch Mountains suggest that the uplands were ice-free by 11,000 years before present[1] (B.P.) (Vance 1986). Prior to this period, the study area was covered by a thick sheet of ice which made it uninhabitable. However, a portion of the Birch Mountains may have been exposed prior to deglaciation as a nunatak or glacial island (Bayrock 1961). During deglaciation, ice retreat was irregular and minor re-advances occurred. However, by 9,000 B.P. all of Alberta was deglaciated (Dyke and Prest 1987). The advance and retreat of glacial ice sheets produced many of the landforms in the region today and was also responsible for the movement of considerable amounts of rock over large distances. Additionally, a series of proglacial lakes that formed along the edges of the Laurentide Ice Sheet may have heavily influenced the settlement patterns of groups in the period immediately following deglaciation.

[1] Dates presented in this thesis, unless otherwise stated, are uncalibrated radiocarbon values, which are signified by the annotation "B.P.", representing "years before present" with present set at 1950.

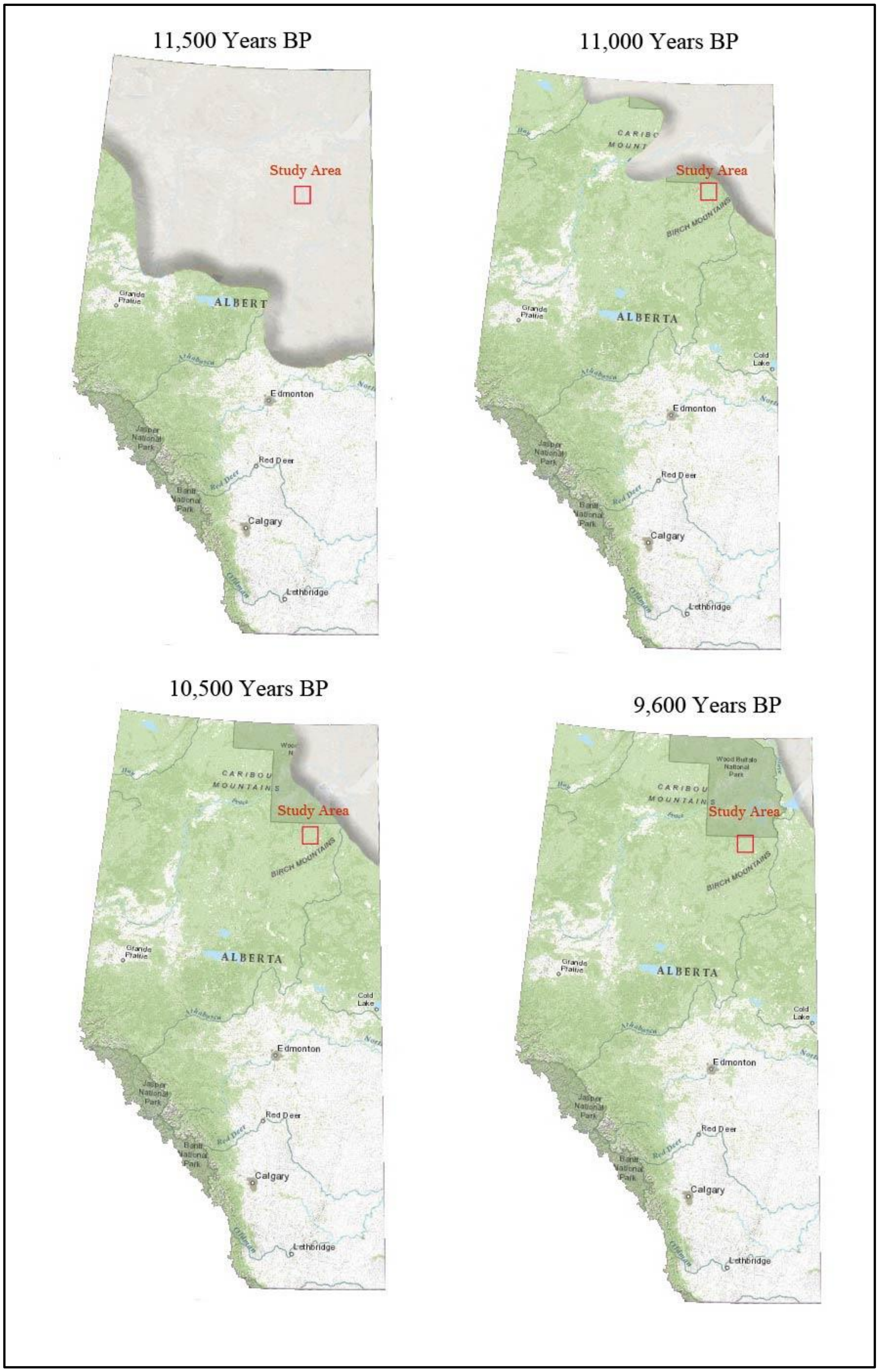


Figure 2.3 Palaeographic maps showing the retreat of the Laurentide ice sheet.

2.3.1 Glacial Lakes

Prior to glacial retreat, the weight of the Laurentide Ice Sheet had down-warped the earth's crust and created a depression that filled with meltwater during deglaciation (Timoney 2013:19). The lake that formed in part of this depression, Glacial Lake McConnell, occupied parts of the Great Bear, Great Slave and Athabasca Lake basins and existed from 11,700 to 9,300 B.P. (Smith 1994:829, Timoney 2013:19). Another glacial lake, Lake Agassiz, stretched from the Clearwater River into Saskatchewan, Manitoba, northwestern Ontario, and parts of Minnesota and North Dakota. It existed between 13,560 and 8,840 B.P. (Fisher and Smith 1994; Michalek 2013; Smith 1994).

As the Laurentide Ice Sheet continued to retreat, the water levels within Lake Agassiz were highly variable. As a result, the lake constantly drained and then refilled. At various points throughout the lake's history it drained south and east into the Missouri River system and through the Great Lakes and Saint Lawrence River. However, an additional drainage route followed the Clearwater and Athabasca River system to the west and north (Fisher and Smith 1994; Kehew and Teller 1994; Michalek 2013).

Between 13,000 and 11,000 B.P., a massive flood sluiced along this northeastern route altering the existing landscape (Fisher et al. 2009; Woywitka and Kristensen 2015). This event, known as the Clearwater Athabasca spillway event, is estimated to have lasted 1.5 to 3 years at a discharge rate of 500,000 m^3/s (Fisher et al. 2002) [2]. The source of the flood is suspected to be Glacial Lake Agassiz, which overflowed its shore lines into the Clearwater River and ran into the lower Athabasca River Valley (Fisher and Smith 1994; Fisher 1993). The flood waters eventually entered into Glacial Lake McConnell and were released into the Beaufort Sea via the Mackenzie River system.

The flood ripped up the underlying bedrock and deposited massive amounts of sediment and boulders along the margins of the lower Clearwater and Athabasca River Valleys. The exposed bedrock and stone material that was uncovered during this event became an important lithic source for the early human occupants of the region (Woywitka and Kristensen 2015; see discussion on Beaver River Sandstone in Chapter 3, Section 3.1.2.1). Following the Clearwater -

[2] To place this number in perspective, the average flow over the Niagara Falls is about 2,400 m^3/s (World Waterfall Database 2016).

Athabasca spillway event, the Laurentide Ice Sheet continued to retreat and with the weight of the glacial ice removed, the downward-warped land began to rebound. Approximately 9,300 B.P., the continued lowering of Glacial Lake McConnell caused it to split into two water bodies: Lake Athabasca and Great Slave Lake (Smith 1994; Timoney 2013).

2.4 Landforms

The geomorphic processes induced by glacial activity and meltwater flooding created various landforms on the landscape with which archaeological sites are often associated. In the boreal forest, many sites are found on prominent and low relief landforms that are in close relation to wetlands and organic terrain (e.g., Foster 2013; Roskowski et al. 2012). As the Laurentide ice retreated across northern Alberta, distinctive ridges and depressions, known as flutings, were revealed (Shaw et al. 2000). Additionally, as water levels in Glacial Lake McConnell decreased, sand deposits were eroded and redeposited by strong southeasterly winds creating numerous aeolian features (Timoney 2013:51; Woywitka et al. 2017). These aeolian sediments built upon existing topography and created new landforms within the study region. Prior to the development of peatlands (Section 2.6.1), both the landforms and the adjacent low-lying areas would have been available for human occupation. However, as muskeg began to form in the low-lying areas, groups would have been more inclined to camp on the dry, elevated landforms, at least during the summer.

2.5 Soils

The current soils within the study area consist mainly of Orthic Gray Luvisols and Dystric Brunisols (Fisher 2007; Natural Resources Committee 2006). Mesisols are also present in wetlands and occupy approximately 15 percent of the Upper Boreal Highlands natural sub-region (Natural Resources Committee 2006). The soils within the Eaglenest Portage site were almost exclusively identified as Eluviated Dystric Brunisols (Ives 1985:19). Dystric Brunisols are acidic soils that "lack a well-developed mineral-organic surface horizon" and typically occur under forest vegetation (Agriculture and Agri-Food Canada 2013). These soils contain an organic leaf litter horizon (LFH) overlaying a very thin Ah horizon composed of decaying organic matter. Eluviated Dystric Brunisols also contain an eluvial horizon (Ae) that is at least 2 cm thick and is characterized by the eluviation of organic matter (Agriculture and Agri-Food Canada 2013). This horizon is typically more lightly coloured than the underlying B horizon. Figure 2.4 shows a soil profile of the Brunisolic soils that were observed at the Eaglenest Portage site. In addition to the typical soil profiles recorded by Ives, some areas of the site were also found to contain buried soil horizons (Donahue 1976:63; Ives 1985:11,32). Buried soil horizons were also noted during fieldwork conducted in 2014 (Figures 2.5 and 2.6).

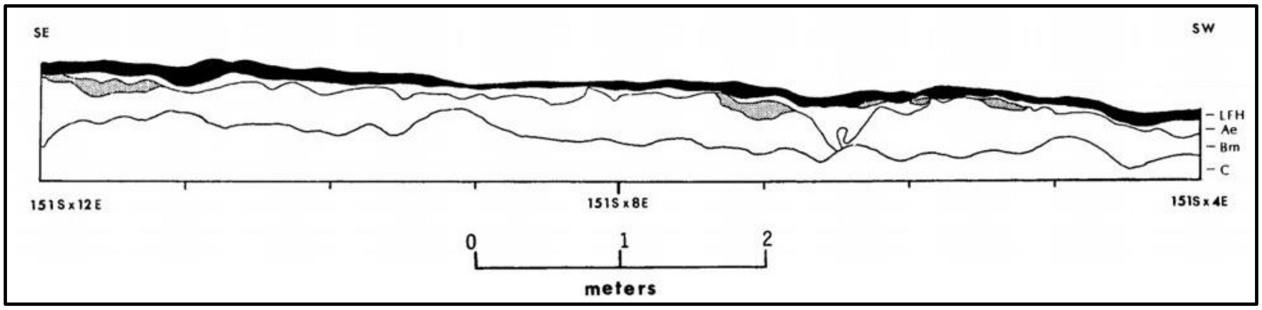


Figure 2.4 Soil profile showing the typical Brunisolic soils of the Eaglenest Portage site. The gray areas represent lenses of tan-coloured sands of unknown origin (Ives 1985:20).

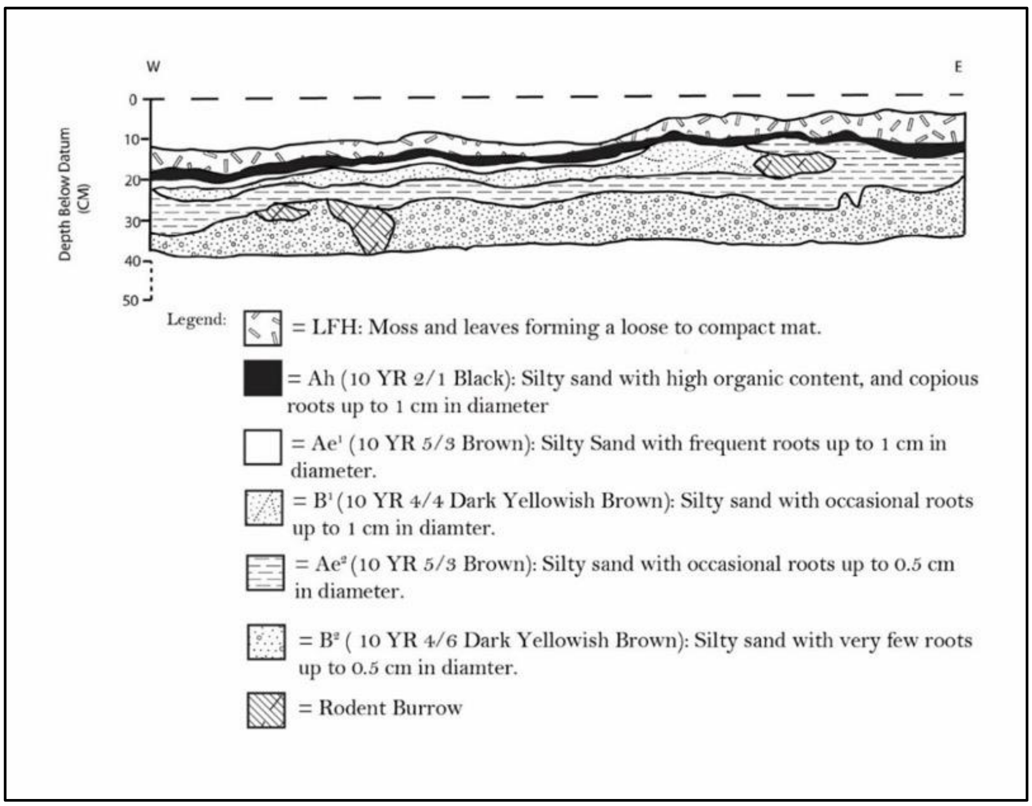


Figure 2.5 Soil profile of excavation units from the 2014 excavation of Eaglenest Portage. A buried Ae soil horizon was noted in these units.

Figure 2.6 A) East wall profile of unit 67 in Block C. A buried Ae soil horizon (indicated by the red arrow) dipped as low as 20 cm beneath surface in this unit (photograph courtesy of Royal Alberta Museum). B) A shovel test excavated in 2014 near Ives Block B.

2.6 Palaeoenvironment

2.6.1 Palaeoclimate and Flora

Vance's pollen analysis of a sediment core from Eaglenest Lake offers direct evidence for the postglacial development of vegetation within the study area (Vance 1986). Vance distinguished three pollen zones within the sediment core: EL1 (11,800 to 11,000 B.P.), EL2 (11,000 to 7,500 B.P.) and EL3 (7,500 B.P. to present). Vance further subdivided pollen zone EL2 into two subzones: EL2a (11,000 to 9,750 B.P.) and EL2b (9,750 to 7,500 B.P.) (Vance 1986: 14).

Pollen zone EL1 reflects conditions occurring immediately after deglaciation as an open parkland or grassland environment developed. The vegetation during this period was composed mainly of nonarboreal taxa such as sage (*Artemisia*), grasses (Poaceae), and sedges (Cyperaceae). However, arboreal species such as poplar (*Populus*) and willow (*Salix*) were present in small amounts. The climatic conditions at this time were mostly dry and windy, with growing-season temperatures much warmer than at present (Vance 1986:17).

Pollen zone EL2 was characterized by an open forest environment with large amounts of spruce (*Picea*) and birch (*Betula*). Vance made the decision to split pollen zone EL2 into two subzones based on the higher presence of alder (*Alnus*) in EL2b. From 11,000 to 9,000 B.P. windy, dry conditions persisted; however, a shift in the prevailing wind direction and intensity caused temperatures to slowly decline between 9,000 and 7,500 B.P. (Vance 1986:18). Elsewhere in Alberta, the onset of this period was contemporaneous with that of the Hypsithermal, which, though marked by fluctuating conditions, was, on average, warmer and drier than the preceding period of glacial retreat (Beaudoin and Oetelaar 2003:199-200). Cool and moist conditions may have developed near Eaglenest Lake during this time frame as a result of its elevation in the Birch Mountains (Vance 1986).

The presence of pine (*Pinus*) marked the beginning of EL3 and a boreal environment developed that is similar to modern day. For the most part, vegetation in the study region has remained relatively unchanged since 7,500 B.P., suggesting climatic conditions were comparable to those at present (Vance 1986:19). However, between 8,000 to 6,000 B.P. substantial peat accumulations formed, and bogs, fens, and muskeg continued to develop until about 2,000 B.P. (Hutton et al. 1994; MacDonald 1987) and remain a prominent feature of the landscape.

2.6.2 Palaeofauna

Due to the highly acidic nature of soils and sediments in the boreal forest, faunal specimens are typically fragmentary and unidentifiable (Section 1.2). Therefore, very little bone has been recovered which can give us insight into the study area's palaeofauna. However, studies conducted in the Peace River district offer valuable information regarding faunal taxa present in northern Alberta shortly after deglaciation. Here, downcutting by three major river systems resulted in a series of graveled terraces where many mammalian fossils have been recovered (Churcher and Wilson 1979). In the earliest terrace (estimated to be 10,500 B.P., or older), extinct species such as woolly mammoth (*Mammuthus primigenius*), horse (*Equus* sp.), and camelids were recovered. Additionally, large ungulates such as elk (*Cervus canadensis*), musk-ox (*Ovibus moschatus*), and three or four forms of bison (*Bison* spp.) were found.

Further west, at the Charlie Lake Cave site in northeastern British Columbia, a number of animal remains were uncovered that show a range of animals were present in the years following deglaciation (Driver 1988; Driver et al. 1996). Here, in subzone IIa (10,700 to 10,000 B.P.) numerous ground squirrels (*Sciuridae* spp.) were discovered, as well as small numbers of snowshoe hare (*Lepus americanus*), bison (*Bison* sp.) and unidentified fish bones. In subzone IIb (10,000 to 9,000 B.P.) a single specimen identified as collared lemming (*Dicrostonyx torquatus*) was recovered. Today, this species is confined to tundra environments; however, during the late Pleistocene it lived south of the ice sheets (Driver et al 1996: 275; Lundelius et al., 1983). Subzone IIb also showed a marked decrease in ground squirrels, which disappear entirely by 9,000 B.P. This decrease is accompanied by an increased frequency of snowshoe hare remains. Driver et al (1996:275) argues that this marks the transition from an open grassland environment to a more closed forest environment. In subzone IIIa (7,800 ± 800 B.P.), Driver (1988) found evidence of beaver (*Castor canadensis*), red fox (*Vulpes vulpes*), lynx (*Lynx lynx*), and moose (*Alces alces*) and in zone IIIc (7,800 to 4,800 B.P.) black bear (*Ursus americanus*) was also discovered, suggesting an environment similar to today.

The location of Eaglenest Portage site, between two major lakes, places it in a strategic location for fishing, which provided an important resource for groups who inhabited the area. Stewart and Lindsey (1983:393) argue that cold-adapted fish species such as white sucker (*Catostomus commersoni*), burbot (*Lota lota*), northern pike (*Esox lucius*), and lake trout (*Salvelinus namaycush*) entered into Lake Agassiz before 12,000 B.P. Additionally, Rempel and

Smith (1998:895-896) indicate that 27 of the 28 fish species in the Clearwater River originate from the Mississippi River, and that these fish likely migrated into the region via overflow from Glacial Lake Agassiz. This suggests that the present-day fish found in Eaglenest and Clear Lakes (Section 2.7.2), such as northern pike and lake trout, migrated into the region shortly after deglaciation.

2.7 Modern Environment

2.7.1 Present Day Flora

The Upper Boreal Highlands natural sub-region is home to a vast mixedwood coniferous forest, interspersed with extensive wetlands and small lakes (National Regions Committee 2006). Traditional land use studies suggest that the study area contains key resources that are utilized both for food and medicinal purposes (Fort McKay First Nation 1994). A wide variety of vegetation located within the study area may have been used by both pre-contact and post-contact groups who occupied the region. On elevated landforms with well-drained soils, trees such as jack pine (*Pinus banksiana*), aspen (*Populus tremuloides*), and white spruce (*Picea glauca*) flourish. The forest understory consists of a number of shrubs and flowers such as bearberry (*Arctostaphylos uva-ursi*), blueberry (*Vaccinium myrtilloides*), green alder (*Alnus crispa*), prickly rose (*Rosa acicularis*), and low-bush cranberry (*Viburnum edule*). Imperfectly to poorly drained areas such as those near bogs and fens contain trees such as black spruce (*Picea mariana*), tamarack (*Larix larcina*), and willow (*Salix*), with an understory consisting of a variety of herbs and shrubs such as Labrador tea (*Ledum*), bog cranberry (*Oxycoccus palustris*), honeysuckle (*Lonicera dioioca* var. *glaucescens*), and feathermosses (*Ptilium*).

2.7.2 Present Day Fauna

The vegetation and wetlands located in the study area attract a variety of game species that could have potentially provided an ample source of food during pre-contact times. Today the area is frequented by large game animals such as moose, woodland caribou (*Rangifer tarandus caribou*), black bear, white-tailed deer (*Odocoileus virginianus*), and grey wolf (*Canis lupus*). Small game animals such as marten (*Martes* spp.), beaver (*Castor canadensis*), mink (*Neovison vison*), lynx (*Lynx lynx*), and squirrel (*Sciuridae* sp.) can also be found (Fort McKay First Nation 1994; Tanner et al. 2001). Wood bison (*Bison bison athabascae*) do not frequent the Birch Mountains today. However, there is evidence in early fur trade journals and oral histories that they were present in the past (Coutu and Hoffman-Mercredi 1999:103; Ives 1993:26). Namur

Lake, for example, is termed Buffalo Lake by some members of Fort McKay First Nation, who tell a story of hunters following bison tracks along the Birch River to Namur Lake (Fort McKay First Nation 1994:97). The presence of wood bison in the region undoubtedly would have attracted pre-contact peoples into the study area.

Various avian species exist in the Birch Mountains and were likely used for a number of subsistence purposes in pre-contact times. Such species include the Canada goose (*Branta canadensis*), sharp-tailed grouse (*Tympanuchus phasianellus*), ruffed grouse (*Bonasa umbellus*), spruce grouse (*Canachites canadensis*), willow ptarmigan (*Lagopus lagopus*), eagle (*Aquila* sp.), mallard duck (*Anas platyrhynchos*), pintail duck (*Anas acuta)*, seagull (*Larus* sp.), pelican (*Pelecanus* sp.), and owl (Family Strigidae) (Donahue 1975:6-7; Fort McKay First Nation 1994). Interviews with First Nation groups who frequent the area reveal that while a variety of these species can be eaten, they also serve a number of other practical uses (Fort McKay First Nation 1994). For instance, eagles and pelicans provide an excellent source of feathers, and pelican pouches can be used as waterproof storage containers for a variety of small items (Fort McKay First Nation 1994:25).

Eaglenest and Clear Lakes both contain a number of different fish species that would have provided a good source of protein for groups who occupied the Eaglenest Portage site. Early ethnographic sources suggest that groups residing in the boreal forest sometimes would resort to lake fish when the hunting of big game animals failed (Goddard 1916:216). Fish such as lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox Lucius*), and walleye (*Stizostedion vitreum vitreum*) would have provided an abundant food source for pre-contact peoples who camped at the Eaglenest Portage site (Donahue 1975; Ives 1985; Fort McKay First Nation 1994).

2.8 Conclusion

When the Laurentide Ice Sheet retreated from northern Alberta, approximately 11,500 B.P., a newly exposed environment developed. The earliest human occupants would have encountered an open grassland environment with sparse vegetation that supported grazing herd animals, including several species or subspecies of bison, woolly mammoth, camel, horse, and several smaller animals such as rabbit and ground squirrel. Massive glacial lakes, which probably contained various fish species that migrated into the area through Glacial Lake Agassiz, would have influenced the settlement patterns of the initial human groups who occupied this region.

At approximately 9,300 B.P. the water levels of Glacial Lake McConnell diminished, and immense quantities of sand were left behind, which helped to create numerous aeolian features. Between 11,000 and 7,500 B.P., spruce trees migrated into the study area, forming an open forest environment that replaced the initial sparse grasslands. Around 7,500 B.P., as the environment shifted to a more boreal setting, game species such as black bear, moose, woodland caribou and woodland bison were available for the pre-contact groups who occupied the study region.

Game species located in the study area tend to be widely dispersed and solitary. This distribution of prey animals is reflected in the fact that, in the boreal forest, human groups typically have small population densities that are highly mobile (Ives 2017:286; Le Blanc 2006:134). When the hunting of large game animals proved difficult, sites situated near large waterbodies may have been important fishing centers. The location of the Eaglenest Portage site, would have also served as a natural stopping point due to its location near two large lakes joined by a stream that cannot be navigated by canoe.

CHAPTER 3: PREVIOUS ARCHAEOLGICAL WORK IN NORTHERN ALBERTA

3.1 Introduction

Despite being the largest ecoregion in Alberta the boreal forest has received relatively little attention from archaeologists when compared to the grassland and parkland regions to the south. This may be, to some extent, due to accessibility issues, as many of the sites can only be accessed by all-terrain vehicles, float planes, or helicopters. As a result, a majority of the research has resulted from historic resource impact assessments required by the *Historical Resources Act* of Alberta (Government of Alberta 2000). For this reason, while archaeologists researching the area can rely in part on data collected by academic archaeologists, much of the available information must be derived from the grey literature reports produced by consulting archaeologists.

3.1.1 Archaeological Research in Northern Alberta

A general lack of stratified sites and organic materials in northern Alberta has presented archaeologists with challenges rarely seen in other parts of the province (Section 1.1). Work in the Birch Mountains has for the most part been driven by research aimed in part at addressing these issues. Work in the lower Athabasca on the other hand, has been largely driven by development and has been conducted by archaeological consulting firms. This work has provided a plethora of information regarding site distribution and organization in the boreal forest. Since the 1970s, archaeologists have gathered an immense amount of data resulting in a better understanding of northern Alberta's past. This section will first provide an overview of some of the more important archaeological research that has taken place in the Birch Mountains. A detailed summary of work conducted in the adjacent lower Athabasca River valley will also be discussed, followed by a description of some of the relevant research that has taken place in areas peripheral to the study region.

3.1.2 Archaeological Research in Birch Mountains

Archaeological research in the Birch Mountains began in 1975, when Donahue (1976) conducted an archaeological survey that focused on Eaglenest Lake, Clear Lake, Sandy Lake, Big Island Lake, and Gardiner Lake (Figure 3.1). The same year, Sims conducted a survey of Namur and South Gardiner Lakes and located the extremely productive Gardiner Lake Narrows (HjPd-1) site (Ives 1981:130). A total of 49 sites were identified by these two surveys, including the Eaglenest Portage site. Here, Donahue excavated a total of 16 subsurface test pits and recovered a variety of different types of lithic debitage as well as three complete projectile points (Donahue 1976:63). Donahue noted that the site was spatially extensive enough to merit further testing, and Ives conducted controlled block excavations at the site in the subsequent field season (Ives 1977, 1985). The details of Ives' excavation will be discussed in greater detail in Section 3.2.1.1.

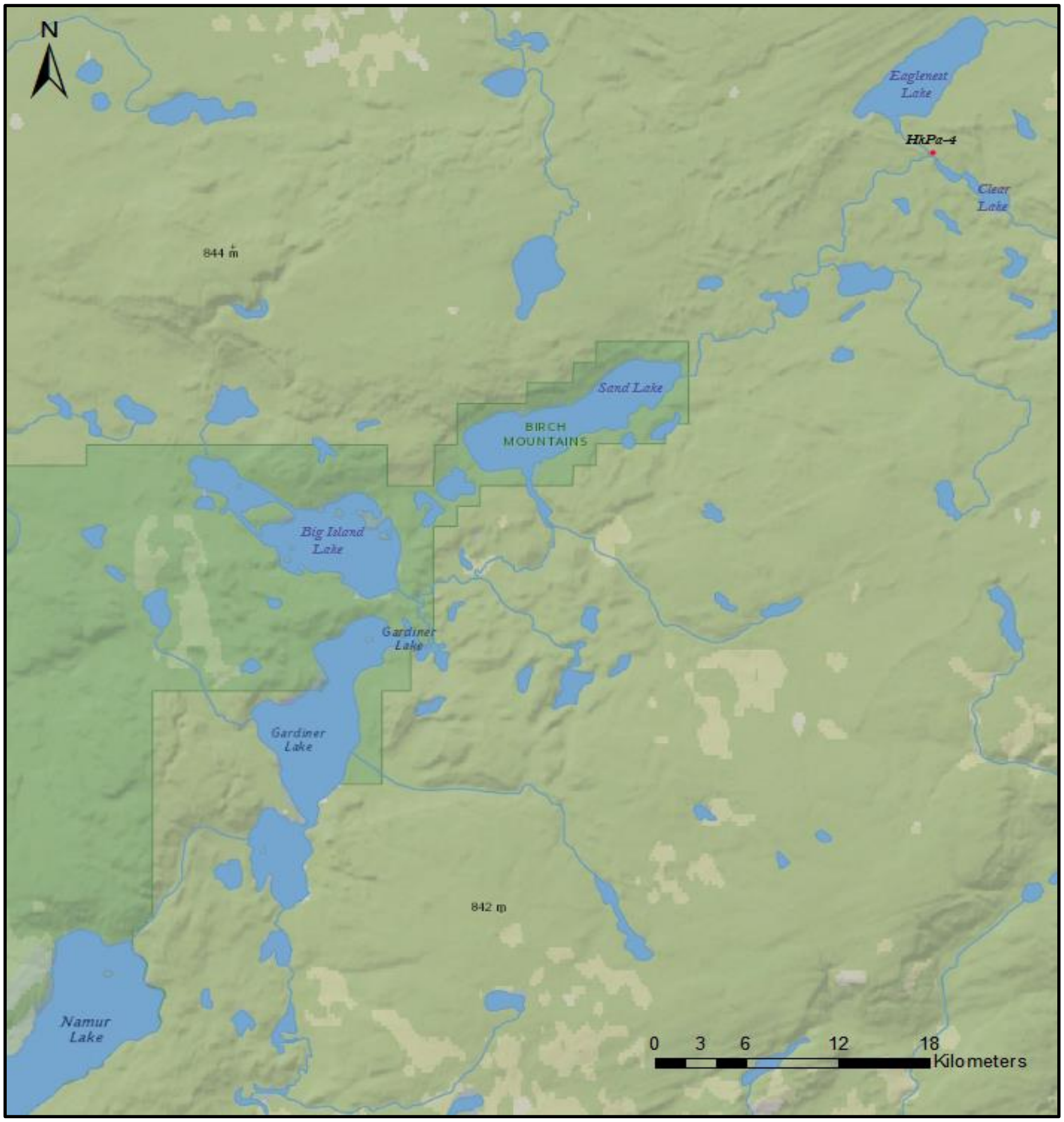


Figure 3.1 Map showing lakes located in the central Birch Mountain Depression.

In 1975, Sims (1976a:1) excavated 253 1-m^2 units at the Gardiner Lake Narrows site in order "to establish a culture chronology for northeastern Alberta". The site turned out to be one of the largest and most productive sites in the Birch Mountains. A total of 61 projectile points, 180 end-scrapers, 125 side-scrapers, and 30 bifaces were recovered (Sims 1976a:3).

Additionally, hammerstones, chi-thos, choppers, cores, net weights, anvils, knives, an awl tip and a possible burin were all noted by Sims in his preliminary report. The site and its materials were to serve as the basis for a PhD dissertation, but unfortunately the dissertation was never finished and consequently the Gardiner Lake Narrows materials have yet to be thoroughly documented (Ives, personal communication 2013).

In 1980 and 1981, Ives (1981, 1982) undertook investigations around Eaglenest and Clear Lakes. As a result, 25 new sites were discovered, and several sites saw exploratory excavations of multiple 1-m^2 units. Although most of these sites were relatively small, a few are worth noting. The Tuxamale Site (HkPa-13) was particularly interesting, as it was found under a peat bog. Ives (1982) attempted to deal with the lack of radiocarbon dates directly attributable to human occupation by dating the basal layer of the peat deposit, producing a value of 2030 ± 105 years B.P. (Ives 1981:136). He surmised that, because the artifacts were all found immediately below the organic deposit, this date likely represented the latest possible date for the site's occupation. Although this method is not ideal, it does offer one method of obtaining an upper limiting date where there otherwise would be none.

On the northeast end of Eaglenest Lake, Ives (1981:66) excavated 6 1-m^2 units at the Pelican Beach site (HkPa-14). Although this site contained no diagnostic materials, it is one of the few known stratified sites in the northern Alberta boreal region. Ives took charcoal samples from the site which yielded dates spanning the last 2,000 years. The artifact assemblage from the Pelican Beach site consisted almost entirely of gray quartzite debitage (Ives 2017:302).

Another site recorded by Ives in the early 1980s was the Satsi site (HkPb-1). The Satsi site represents the third largest site known in the Birch Mountains and a total of 32 m^2 were excavated. During excavations Ives (1982:67) recovered bifaces, side and end scrapers, a single retouched flake and several projectile points. The Satsi site is also noteworthy due to an archaeological feature that was recognized during excavations; features in the boreal forest are often not identified because soil conditions and other agents of disturbance (Section 5.2.2) make them hard to recognize. Ives (1986) compared the attributes of the feature to photographs of ethnographic Chilcotin smudge pits from central British Columbia and noted that the Satsi feature was similar. Along with the ash and charcoal fragments contained in the basin of the feature, there were a number of charred green spruce cones. Ives concluded that the configuration of the feature, along with the use of spruce cones to create a smoky environment, was consistent with that of a smudge pit. Many smudge pits are used during the hide preparation process. However, Ives (2017:301) notes that it may also have been used to provide relief from insects.

The most recent research in the Birch Mountains, prior to that detailed in this thesis, took place in 2004, when Ronaghan and Ives took part in a biophysical inventory of the Birch Mountains Wildland Provincial Park (Ives 2017:309-310). A forest fire that occurred prior to 2004 cleared the area around Namur Lake of vegetation and allowed Ronaghan and Ives to identify and record five sites in less than three days of survey. A more extensive survey would conceivably locate even more sites.

At the time of writing, PetroChina Limited holds the rights to build its Dover Commercial project near Gardiner Lake (Stastny 2013; Healing 2014). If the project continues, archaeological consulting companies will undoubtedly collect data that will expand our knowledge of the Birch Mountain region.

3.1.2.1 Excavation of the Eaglenest Portage Site (HkPa-4)

Ives' work at Eaglenest Portage was the first attempt at overcoming the issues presented by the lack of stratigraphy in the Alberta boreal forest. Ives noted that there is very little to no discernible vertical separation of components at most boreal forest archaeological sites, and therefore surmised that the only way to deal with the chronological problems of the boreal forest environment was through careful spatial analytical approaches that could help provide objective horizontal segregation of artifact clusters representing multiple activity areas and different occupations (Ives 1977, 1985). Ives excavated two 25-cm-wide transects across the site to expose artifact concentrations. The use of transects allowed Ives to place excavation blocks in areas that would give a broad sample of the different conditions that existed at the site. Ives purposely excavated in areas that included different artifact densities and different ratios of finished artifacts to gain an objective sample of the range of conditions that were present at the site (Ives 1985:42). Two 4-x-4-m blocks (Blocks A and D) and two 8-x-4-m blocks (Blocks B and C) were placed in areas that these trenches showed to have low, moderate, and high densities of artifacts (Figure 3.2).

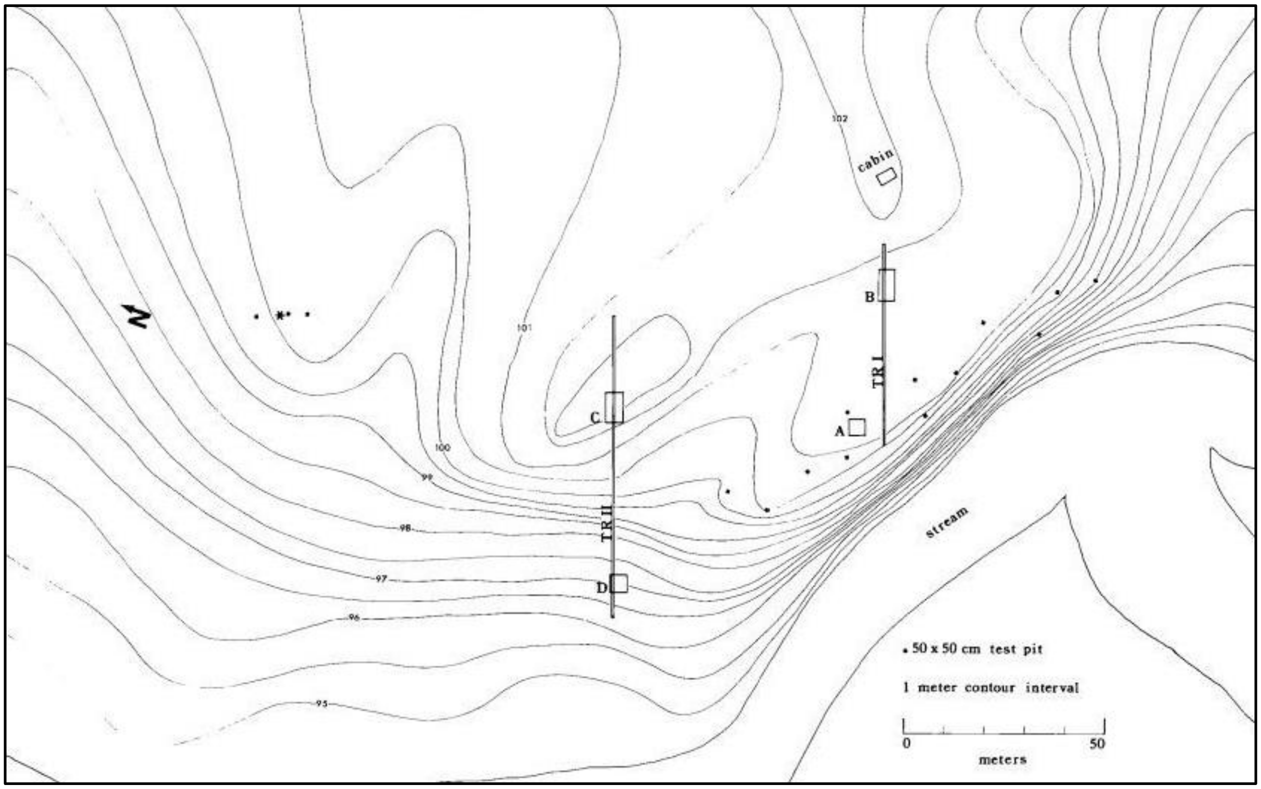


Figure 3.2 Topographic map of HkPa-4 showing shovel tests, excavation blocks, and transects (Ives 1985:18)

A total of 6,721 artifacts were recorded during the 1976 excavations at Eaglenest Portage. The assemblage consisted of debitage including bifacial reduction flakes, block shatter, decortification flakes, and retouch flakes (discussed in greater detail in Chapter 6). Of the total assemblage, just over 300 artifacts were termed "finished artifacts," broadly defined as "artifacts that have been modified by flaking and retouch, or through use wear" (Ives 1985:33). Additionally, Ives defined 11 different raw material categories within the assemblage and grouped each lithic artifact into one of the following categories; quartzite, Beaver River Sandstone (BRS), black chert, other chert, argillite, quartz, salt and pepper quartzite, heat-treated quartzite, heat-treated salt and pepper quartzite, sandstone, and low-grade quartzite (Ives 1985:58).

The variety of lithic resources recovered from Eaglenest Portage encompasses many of the raw materials recovered in the Birch Mountain region including both local and non-locally sourced materials. The most abundant raw material in the Eaglenest Portage assemblage is quartzite (Figure 3.3). Several quartzite varieties exist within the assemblage, the most common of which is what Gryba (2001) has termed Northern Quartzite. Northern Quartzite tends to have a high silica content, which results in a moderate vitreous to glossy luster and is often a honey brown to slightly pale purple grey color. Secondary sources of Northern Quartzite have been discovered in the Birch Mountains uplands in glacial deposits; however, a primary source has yet to be discovered (Gryba 2001:23). Another visually distinctive quartzite is salt and pepper quartzite, which is characterized by small black inclusions in the otherwise clear to white colored grains of silica quartzite. Less distinctive varieties of quartzite also exist within the assemblage such as white and coarse-grained quartzite. Ives only distinguished salt and pepper quartzite and coarse-grained quartzite as unique varieties, and all other quartzites recovered in the Eaglenest materials were simply catalogued into one group.

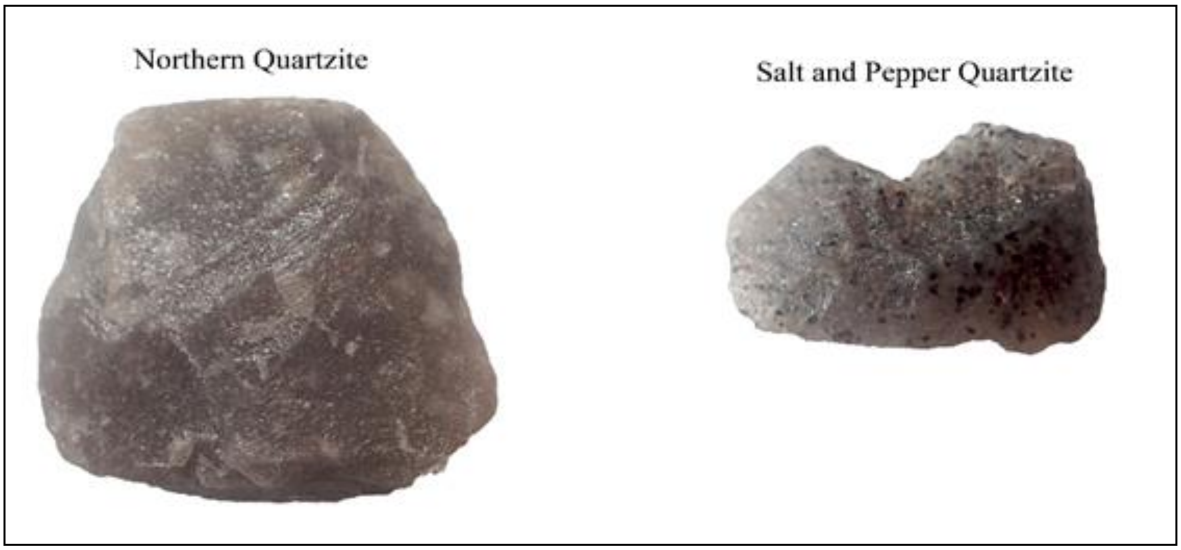


Figure 3.3 Example of quartzite identified in the Eaglenest Portage assemblage

Through experimentation, Ives (1985:34-35) noted that the heating of locally sourced quartzites in an open fire pit lead to observable changes. Heating over red-hot coals for a few minutes resulted in opacity, and prolonged heating caused "siliceous grains to appear in an off-white matrix" (Ives 1985:34). Artifacts from the Eaglenest Portage site that displayed evidence of prolonged heating were catalogued as heat-treated (Figure 3.4). Northern Quartzite can easily be worked by both percussion and pressure flaking in its raw state, although the flaking quality does improve when heated to 550-575 F; an off-white colour in the material may be the result of being over-heated in a campfire (Gryba personal communication, 2016). Since it is impossible to know if artifacts in the assemblage were purposely heated or if they were burned through natural events such as a forest fire, all heated materials from the assemblage will be referred to as "heat-altered".

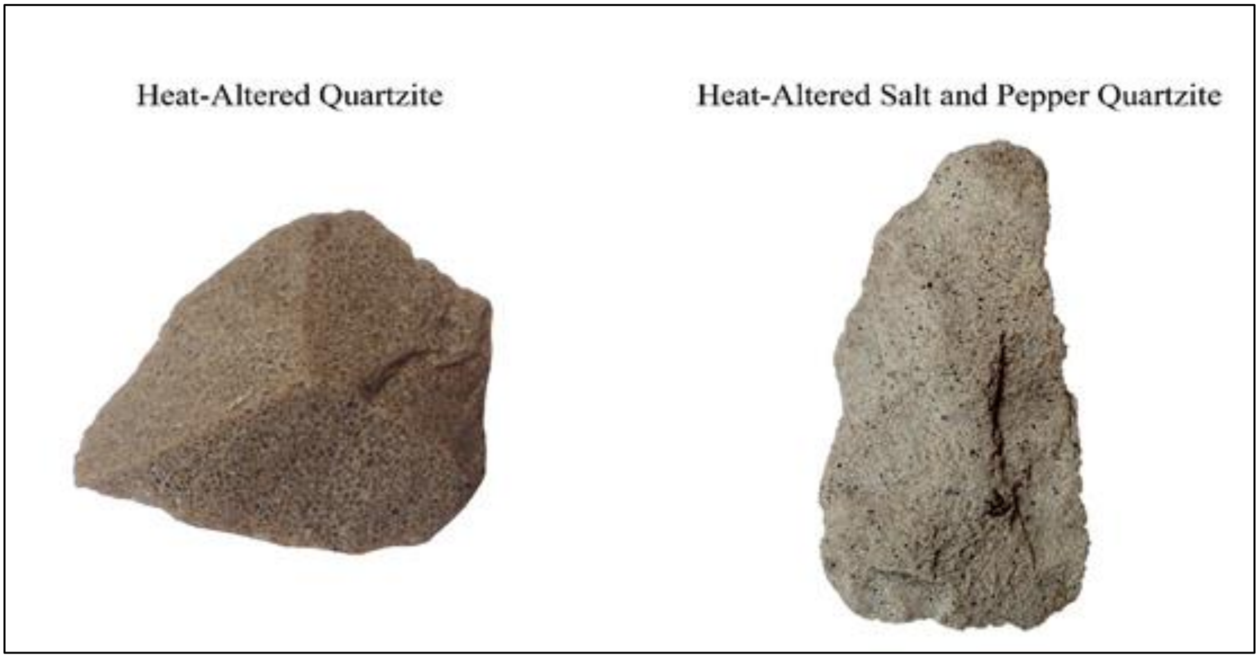


Figure 3.4 Example of heated quartzite identified in the Eaglenest Portage assemblage.

BRS (Figure 3.5) has been known by a variety of names since it was first discovered including Beaver Creek Quartzite, Beaver River Silicified Limestone, Beaver River Silicified Sandstone, and Muskeg Valley Microquartzite (De paoli 2005; Fenton and Ives 1982, 1984; Saxberg and Reeves 2006; Reeves et al. 2017). The identification of quartz inclusions in very fine-grained samples of BRS confirms the material is an orthoquartzite rather than a sandstone (De Paoli 2005:173); however, most researchers prefer to continue using the term “BRS” for reasons of historical consistency. BRS specimens recovered from the Eaglenest Portage site tend to be manufactured out of a high quality BRS that has a chert-like appearance. Most specimens of BRS tend to contain large angular clear quartz crystals in an otherwise uniformly fine-grained matrix (Kristensen et al. 2016a). Faint color banding is noticeable in some of the artifacts recovered from the Eaglenest Portage site, although most tend to be of a dull grey color. Some pieces also exhibit patches of red to orange staining, possibly due to heat-alteration or iron staining (Kristensen et al 2016a:151).

Figure 3.5 Example of BRS identified in the Eaglenest Portage assemblage.

Quartz (Figure 3.6) is one of the most common minerals in the world. Nevertheless, it makes up only a small percentage of the artifacts recovered from the Eaglenest Portage site. Quartz has a vitreous luster, and although it is usually transparent or white, it may be of a variety of colours due to mineral impurities (Kooyman 2000:28). Quartz can be used to form well-made tools; however, it sometimes fractures unpredictably (Whittaker 1994:67). Vein quartz refers to quartz that is deposited as thin layers in other material. In larger deposits it is termed crystalline or massive quartz (Kooyman 2000:28). Artifacts composed of quartz occur rarely in northern Alberta, but appear more frequently in northern Saskatchewan (Martindale 2014:29).

Figure 3.6 Example of quartz identified in the Eaglenest Portage assemblage.

Tertiary Hills Clinker (THC) (Figure 3.7) is a poorly known lithic raw material that is easy to misidentify (Kristensen et al. 2016b). It was first identified by MacNeish (1954:248), who called it Keele River Obsidian. It has also been called Keele River Welded Tuff (Donahue 1976), ignimbrite (Millar 1968) and Tertiary Hills Welded Tuff (Cinq-Mars 1973; Ives and Hardy 1983). THC can resemble fine-grained quartzite or quartz, as well as chert or chalcedony, which contributes to it often being misidentified (Kristensen et al. 2016b). A key characteristic of THC is distinct vesicles or gas bubbles that give the material a frosted-glass texture with a vitreous lustre (Ives and Hardy 1983; Kristensen et al 2016b). Only a single flake of THC was discovered at the Eaglenest Portage site.

Figure 3.7 Tertiary Hills Clinker identified in the Eaglenest Portage assemblage.

Many other lithic raw materials were recovered from the Eaglenest Portage site including chert, argillite, and sandstone. Ives differentiated chert recovered from the Eaglenest Portage site into two categories, “black chert” and “other chert”. A more detailed analysis of the chert recovered from the Eaglenest Portage site will be discussed in Chapter 5.

In addition to the artifacts recorded by Ives, three features were also identified, although two of these three features were later determined to be natural phenomena. The third feature, however, consisted of an irregularly shaped segment of a buried Ae soil horizon that extended over portions of 6 m^2 (Figure 3.8). The buried Ae horizon in these units had a rosy hue which may have been indicative of intense heating (Ives 1977:17). Ives noted that while it is conceivable that this feature may have been an isolated segment of a living floor, it is also possible that it resulted from a forest fire (Ives 1977:17).

Figure 3.8 Photograph showing the buried Ae horizon in units 59 and 63 (Photograph courtesy Royal Alberta Museum).

Ives (1985:116-117) used various statistical clustering techniques, including nearest neighbour analysis to define spatial clusters of finished artifacts, and mean square block analysis to define patterns among spatial clusters. These methods documented that discrete horizontal spatial clusters of finished artifacts could be defined under some circumstances. In total, 18 spatial clusters were defined by Ives, including two in Block A, five in Block B, eight in Block C, and three in Block D. Ives concluded that areas with a high density of artifacts are susceptible to “the effects of cluster overlap and natural disturbance” (Ives 1985:112). Therefore, his techniques are best suited for moderate density areas which would allow for spatial analytical techniques to disentangle distributions meaningfully (Ives, personal communication 2013). Ives study focused only on the distribution of finished artifacts; however, with the advent of more sophisticated computer-based statistical methods available today, a re-analysis of the entire assemblage can give us new and valuable information.

3.1.3 Archaeological Research in the Lower Athabasca

Archaeological investigations of the lower Athabasca River Valley began in 1973 with a series of archaeological surveys conducted on behalf of Syncrude Canada (Sims 1974:3). During the investigations 31 sites were discovered, a majority of which were small campsites and workshops. Archaeological investigations continued on behalf of Shell Canada, and an additional 47 sites were discovered (Sims 1974:4). One trend noted by archaeologists working in northern Alberta was that while quartzite dominated assemblages in the Birch Mountains, the lower Athabasca contained a high percentage of artifacts manufactured out of BRS. One large quarry site, the Beaver Creek Quarry (HgOv-29), was discovered and excavated by Sims (Syncrude 1974). When this site was first discovered, it was initially thought to be the primary source of BRS. The evidence gathered from these investigations led Sims to believe the area was first occupied as early as 8,000 B.P. Furthermore, Sims noted that sites were mainly discovered in areas that were in close proximity to watercourses and areas of environmental diversity.

One of the most extensive sites located in the Athabasca lowlands is the Cree Burn Lake site, which runs parallel to a lenticular oxbow lake known as Isadora Lake. The site was first discovered in 1973 (Losey and Sims 1975), with further testing conducted in 1976 (Sims 1976b). At the time, a series of artifact clusters were recorded and classified as separate sites. Subsequent studies provided a better estimate of the extent and complexity of the site, and as a result some 20 sites were consolidated into a single provincially designated historical resource known as the Cree Burn Lake Site (HhOv-16) (Head and Van Dyke 1990; Shortt and Reeves 1997). A clear majority of the artifacts recovered from the site were fashioned out of BRS. The BRS artifacts recovered from Cree Burn Lake appeared to be manufactured out of a much finer-grade material than the nodules that were discovered from the Beaver Creek Quarry (Reardon 1977; Fenton and Ives 1990) As such, it became evident that there was likely an alternate and superior source of BRS. The high frequency of BRS suggested that an abundant source was located nearby, and the source of this material became a continued subject of interest in the region.

With the expansion of oil sands development in the late 1970s and early 1980s, archaeological research in the lower Athabasca increased dramatically. One major lease, the Alsands lease, was of importance because archaeologists set out to determine if sites might exist in areas that had previously been defined as having low potential, such as those located great distances from significant water sources (Conaty 1979; Ives 1993; Le Blanc and Ives 1986). The study showed that many sites occurred in areas away from the Athabasca River and, in some cases, they were relatively abundant. Throughout the 1980s the number of investigations in the region increased as industry continued to expand.

In 2003, Lifeways of Canada discovered two primary sources of fine-grained Beaver River Sandstone in what has become known as the Quarry of the Ancestors (Saxberg and Reeves 2004). It is believed that this Quarry is the primary source of BRS found at sites such as Cree Burn Lake. The abundance of BRS in the lower Athabasca and the abundance of sites in proximity to the Quarry of the Ancestors suggests its importance to pre-contact groups who occupied the region.

During the 1990s and continuing into the 2000s archaeological consulting firms continued to work in northern Alberta in response to industrial development. These historic resource impact assessment and mitigation (HRIA and HRIM) studies have significantly enhanced the available data for sites located in the oil sands region of the lower Athabasca. One of the more intriguing studies, for example, is that of Roskowski, who excavated sites HhOv-113 and HhOv-114 on behalf of Shell Canada (Roskowski 2015). Although these sites were found in close proximity to the Quarry of the Ancestors, they were observed to differ from most nearby sites in that their assemblages were not entirely dominated by BRS, but also contained a number of exotic materials. Subsequent analysis of the artifact distributions showed that the excavated activity areas tended to be horizontally distributed across the sites and distinguishable by raw material types.

3.1.4 Archaeological Research in Areas Peripheral to the Study Area

Many sites located outside of the lower Athabasca and Birch Mountain regions are also worth noting. For instance, when Donahue (1976) conducted his survey of the Birch Mountains, he also surveyed the Caribou Mountains located north of the Peace River (Figure 2.1). Donahue (1976:111) noted differences in the distribution of raw materials between the two regions. In the Birch Mountains quartzite was found to predominate, whereas in the Caribou Mountains there were much higher percentages of chert. A number of the chert artifacts recovered by Donahue were of a distinctive mottled/banded gray chert, now known as Peace Point Chert (Figure 3.9). In fact, roughly 40 to 50% of all raw material recovered in the Caribou Mountains is of this material (Ives 1993:20). Peace Point Chert also appears in the Birch Mountains, but in smaller percentages. This material has been known to occur in limestone deposits immediately beneath the Peace Point site (IgPc-2); unfortunately, there has been little research into where else this material may or may not be found (Ives, personal communication 2014). Further research into the source of Peace Point Chert may provide insights into the movements of pre-contact people between the Caribou Mountains, the Peace River, and the Birch Mountains.

Figure 3.9 Example of Peace Point Chert debitage recovered from the Eaglenest Portage site.

Also in the 1970s, Wright (1975) surveyed the shores of Lake Athabasca in both Alberta and Saskatchewan. Wright argued that the sites contained projectile points diagnostic of both Northern Plains and Subarctic origins. Wright suggested that the western half of the lake was occupied by Northern Plains hunter and gatherers, while the eastern half of the lake was occupied by boreal forest caribou-hunting societies. This work is important because it introduced the idea that northern Alberta was occupied or influenced by groups located in the region's peripheries (discussed in greater detail in Chapter 4).

The Peace Point site (IgPc-2) located on the Peace River in Wood Buffalo National Park is another significant site in northern Alberta (Stevenson 1986). The site is important because it is one of the few sites in the boreal forest that has been found to contain an extended sequence of discrete stratigraphic layers in which both artifacts and features were extremely well preserved. Excavations at the site revealed 18 different occupation surfaces that extended two metres beneath the surface and dated back as far as 2,200 B.P. (Stevenson 1985;1986). Stone tools and debitage were abundant at the site; however, only one side-notched projectile point was recovered. Another unusual aspect of the Peace Point site was the preservation of organic materials such as spruce needles and fish scales (Stevenson 1986:90). Typically, organic preservation in boreal forest sites is lacking and to see preservation of these materials is highly unusual (Chapter 1, Section 1.2). One Y-shaped cluster of lithic artifacts was interpreted as possibly being representative of debitage dropping between an individual flintknapper's legs (Stevenson 1985:70). The preservation at this site was so excellent that Stevenson (1985) was able to use the data to create a general model for patterns in human use, occupation, and abandonment of archaeological sites. If further work takes place at the site it may prove invaluable to constructing an accurate culture history for northern Alberta.

3.2 Summary

Archaeological research in northern Alberta has been challenging. Throughout the 1970s and 1980s, researchers working in the Birch Mountains made various attempts to deal with some of these challenges. For example, excavations at the Eaglenest Portage site have shown the importance of mapping artifacts in situ to conduct a thorough spatial analysis of a site to determine artifact clusters. Furthermore, Ives' work at the Tuxamale site provides a method for obtaining an upper limiting date for sites buried under peat. Work in the lower Athabasca has largely been conducted by archaeological consulting firms, which have provided a plethora of information regarding site distribution and organization at a macro scale. However, in order to advance our understanding of the region, we need to either focus our attention on finding stratified sites with preserved organic materials such as the Peace Point site, or find a way to gather more data from sites that lack stratified deposits and suitable material for radiocarbon dating.

CHAPTER 4: CULTURE HISTORY

4.1 Introduction

In North America, archaeological cultures are typically defined by the sequential ordering of assemblages of artifacts that are differentiated by morphology and style as well as the associated radiocarbon dates. Despite the immense amount of archaeological research taking place in northern Alberta each year, a detailed understanding of the culture-historical sequence of the region has still not been fully developed. This is in part due to the significant hurdles that the lack of stratified sites and radiocarbon dates have posed for archaeologists who work in a boreal forest environment (Chapter 1, Section 1.2). The aim of this chapter is to provide a general culture chronology of the study region from its initial occupation until present, as it can be best extrapolated based on current data and interpretations. Due to the difficulties in establishing a concrete culture history for the region, relevant research will be explored for surrounding areas, where more research has sometimes been undertaken and where fewer issues in establishing a chronology have been encountered.

4.1.1 Terminology

In order to understand the culture chronologies discussed in this chapter a degree of familiarity with basic archaeological concepts and terms is required. The following is a brief summary of some of the terms and concepts that appear frequently within this chapter.

- *Period:* Traditionally, the archaeological record of Alberta has been divided into temporal segments called periods (Mulloy 1958; Reeves 1983; Peck 2011). In Alberta and in some of the surrounding areas, there is an overarching tendency to use a three-period scheme first developed by Mulloy (1958), which consists of the Early, Middle and Late Pre-contact periods. Within each period are a number of cultural units, which are labelled as either *phases* or *complexes* (Peck 2011:6; Reeves 1983; Vickers 1986:13).
- *Phase:* The term phase is used to describe a group of artifacts that possess similar traits and attributes, and where the relationship to earlier and later assemblages are well understood (Peck 2011:6; Reeves 1983; Vickers 1986:13; Willey and Phillips 1958).
- *Complex:* A complex, describes a group of artifacts that share similar traits and attributes; however, the sequential relationship to earlier and later assemblages are unclear (Dyck 1983:69; Reeves 1983; Peck 2011:6).

- *Tradition:* A continuation of technological or cultural traits occurring within sequential complexes or phases (Dyck 1983:69).
- *Series:* Dyck (1983:69) defines a series as "a crude unit of archaeological analysis used for convenience before sites, features, and artifacts are ready for reclassification into complexes and traditions".
- *Diagnostic:* Artifacts which are typical of a particular complex or phase are termed diagnostic. Due to their unique stylistic variability, projectile points are often the artifacts which are used to mark cultural phases and complexes in the study regions and adjacent areas (Frary 2009:13; Peck and Ives 2001:163), although other artifacts, such as pottery, can be termed as diagnostic as well.

4.2 Chronological Studies in Regions Adjacent to the Study Area

The pre-contact materials recovered from northern Alberta have been noted to share similar technological traits to artifacts recovered from adjacent regions (Donahue 1976; Le Blanc 2004; Martindale 2014; Reeves et al 2017; Wright 1975; Ives 1993; Ives 2017). Furthermore, raw materials recovered from northern Alberta suggest that groups were either trading or travelling to and from areas adjacent to the study area. Artifacts manufactured out of Beaver River Sandstone (BRS) (Chapter 3, Section 3.1.2.1) have been recovered as far south as Oyen (Kristensen et al. 2016a:143), and in various parts of northern Saskatchewan (Martindale 2014). A raw material known as Tertiary Hills Clinker (THC) (Chapter 3, Section 3.1.2.1), has been recovered from various sites in northern Alberta, and has been sourced to an outcrop located approximately 30 km from the Mackenzie River, in the Northwest Territories (Bereziuk 2001; Donahue 1976; Kristensen et al 2016b; Ives and Hardie 1983; Le Blanc 2004:145; Roskowski 2015). As well, obsidian recovered from the study area is often sourced to Mount Edziza in northern British Columbia (Donahue 1976:viii; Reeves et al. 2017:177; Roskowski 2015:246).

There are also multiple rivers and drainages that connect the study area to the lower Athabasca River Valley and the Peace-Athabasca Delta (Figure 4.1). The Peace-Athabasca Delta and the lower Athabasca may have been important travel corridors for pre-contact peoples who, throughout pre-contact times, migrated in and out of the study area from these adjacent regions. Given the similarities in technology, distinct raw materials, and accessible travel routes it is likely that these adjacent regions had an influence on the cultural historical sequence of the study area. Thus, in order to better understand the culture chronology of northern Alberta, this chapter will first consider the culture history of the Northern Plains, the Barrenlands of the Northwest Territories, the Saskatchewan boreal forest, and northeastern British Columbia (Figure 4.2).

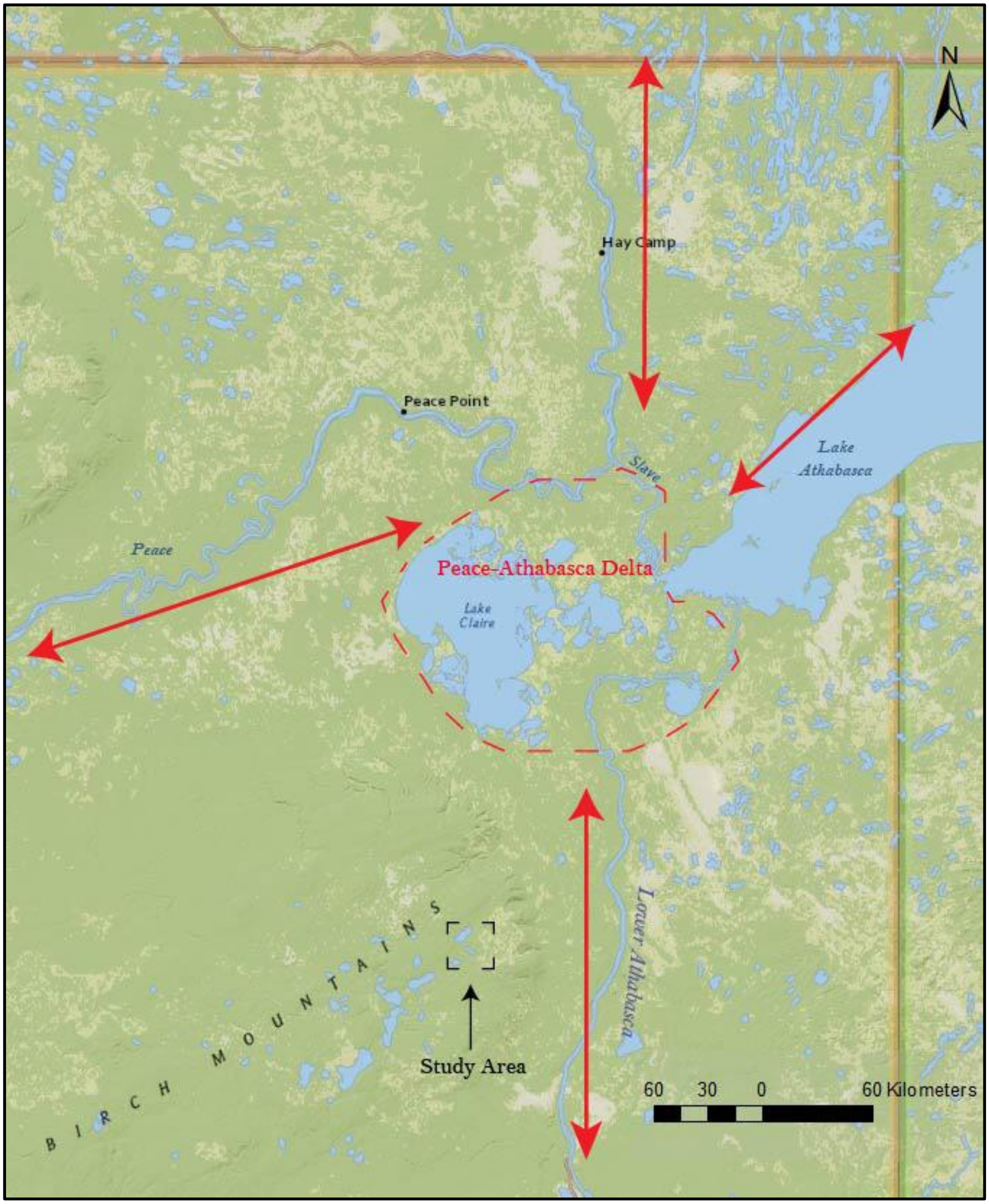


Figure 4.1 Location of the Peace-Athabasca Delta and the lower Athabasca River Valley in relation to the study area. The red arrows indicate potential travel routes to adjacent regions that share similar lithic technologies.

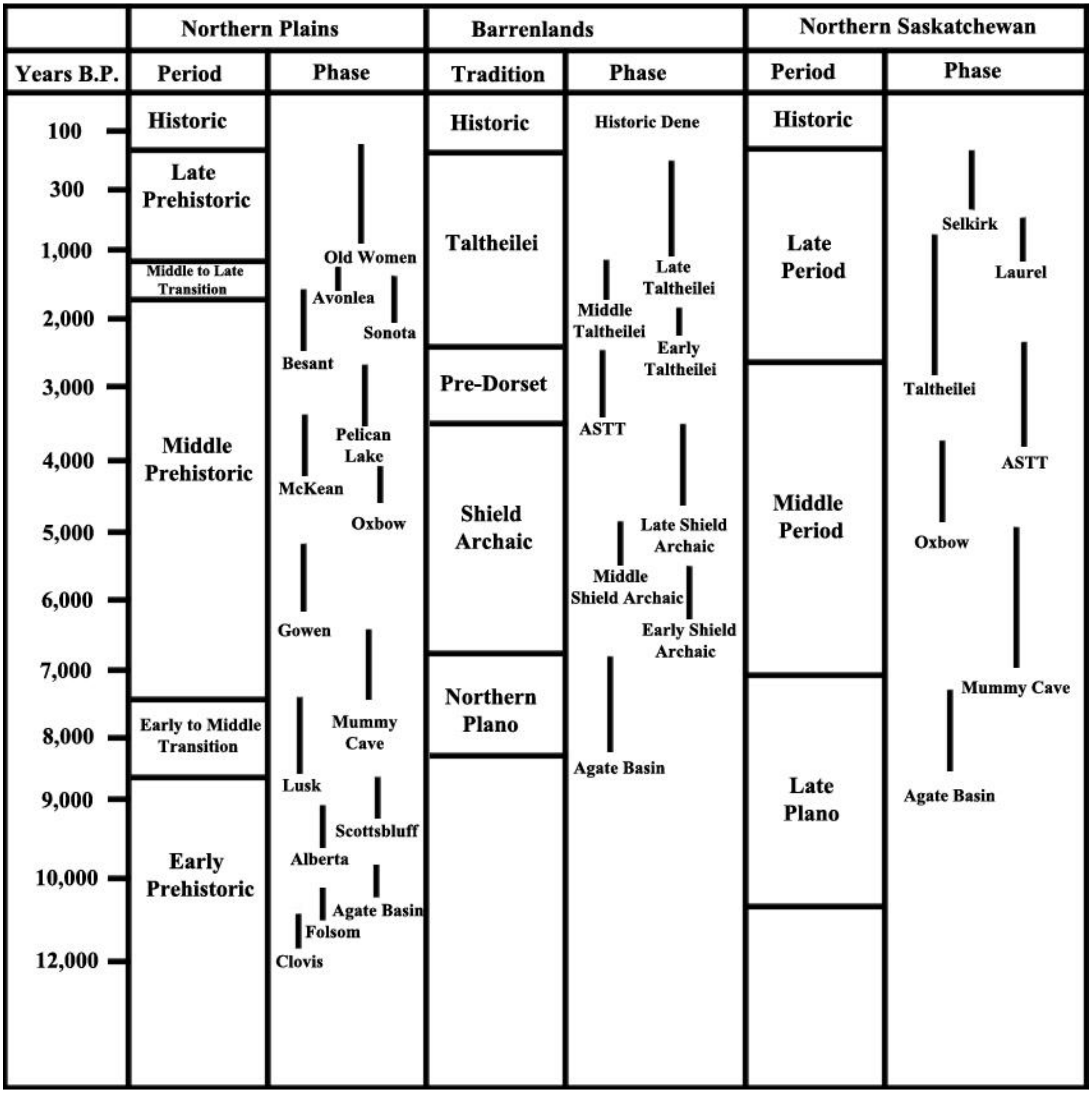


Figure 4.2 General culture history for regions adjacent to northern Alberta.

4.2.1 The Northern Plains

The Northern Plains extends into central and southern Alberta and Saskatchewan and includes upper portions of the Missouri River drainage in central and eastern Montana. This area is the most well-known and extensively researched archaeological region close to the northeastern Alberta study area. William Mulloy (1958) established the first cultural sequence of the Northern Plains. Wormington and Forbis (1965) later designed a classification system for assemblages specific to Alberta. Reeves (1969, 1983) modified Mulloy's framework to reflect an increase in the available data. Vickers (1986) provided an up-to-date review of the cultural sequence as known at that time. The most recent framework was developed by Peck (2011), who provided an updated, comprehensive chronology for the Northern Plains of Alberta. Readers who are interested in a more complete understanding of the Northern Plains culture historical sequence are directed to the aforementioned works, as this chapter will focus mainly on archaeological cultures that are pertinent to the northern Alberta study area. The dates provided for the periods represented in the Northern Plains will follow Peck (2011):

- Early Prehistoric (11,050 to 8,600 B.P.)
- Early Prehistoric to Middle Prehistoric Transition (8,600 to 7,500 B.P.)
- Middle Prehistoric (7,500 to 1,500 B.P.)
- Middle Prehistoric to Late Prehistoric Transition (1,500 to 1,350 B.P.)
- Late Prehistoric (1,350 to 250 B.P.)

4.2.1.1 The Early Prehistoric Period (c. 11,050 to 8,600 B.P.)

The first reasonably well known archaeologically groups to venture into the Northern Plains of Alberta utilized a technology characterized by robust lanceolate fluted projectile points known as Clovis (11,050 to 10,800 B.P.). Ives (2006:27-28) has argued that a distinct Clovis population occupied Alberta and maintained isolation from groups to the south. This is reflected in a style of projectile point, sometimes referred to as “basally-thinned triangular”, which are similar but often shorter than classic Clovis points. Points of this style have been recovered at only a few sites in Alberta (Belanger and Rawluk 2017; Gryba 1983; Peck 2011:49-53). This culture was succeeded shortly thereafter by Folsom (10,900 to 10,200 B.P.). Folsom points are stylistically similar to Clovis, but are smaller in size, and the flute extends almost the entire length of the body. Very few excavated sites in Alberta contain fluted points; however, a large quantity have been documented in the collections of amateur and avocational archaeologists (Ives 2006:13). Clovis hunters successfully hunted mammoth and other Pleistocene megafauna, whereas now-extinct forms of large bison mainly characterize sites from the Folsom era.

Agate Basin and Hell Gap (10,200 to 9,000 B.P.) are two contemporaneous phases that represent the earliest points from the Plano tradition (Peck 2011:55). The Plano tradition was marked by a group of assemblages that consisted of large lanceolate points with parallel flaking (Arnold 1985; Dixon 2000:150; Peck 2011:55). Phases encompassed within this tradition are believed to have followed an economy based primarily on large mammal hunting (Dixon

2000:150). Agate Basin points are long and narrow with a relatively thick cross-section. Hell Gap points are morphologically similar, but with slight shoulders. Frison (1991:62) argues that Hell Gap points developed from Agate Basin points.

Following Agate Basin and Hell Gap there was a continued trend of stemmed projectile points known as the Cody tradition. This tradition includes the Alberta phase (9,600 to 9,000 B.P.), and the Scottsbluff-Eden phase (9,000 to 8,600 B.P.) (Hofman and Graham 1998; Peck 2011:75). The Cody tradition is also marked by a distinctive asymmetrical knife that shows up in assemblages from both the Alberta and Scottsbluff-Eden phases (Peck 2011:92). Alberta projectile points are similar to Scottsbluff points, except they tend to be longer with a broader stem, abrupt shoulders and a blunted tip. Scottsbluff points can be divided into three different types (Kooyman 2000) but are generally triangular with small shoulders and exhibit frequent basal grinding. Eden points are fairly similar to Scottsbluff points but lack the prominent stem. Like their predecessors, the people of the Cody tradition continued to hunt large game animals such as bison (Dawe 2013).

4.2.1.2 The Early to Middle Transition Period (8,600 to 7,500 B.P.)

According to Peck (2011) the Early to Middle transition period in Alberta is represented by the Plains/Mountain phase (8,600 to 7,700 BP) in the foothills/mountains and the Lusk phase in the Plains (8,300 to 7,500 BP). Lusk projectile points are typically lanceolate with a concave base and a plano-convex cross-section (Peck 2011:108). Lusk points are sometimes recovered in single component sites that also contain corner-notched projectile points. Some researchers believe that Lusk points represent a transition between spear points and atlatl dart points (Peck 2011:118). However, evidence exists that the atlatl was used as early as the Clovis phase (Dixon 1999:151-153).

4.2.1.3 The Middle Prehistoric Period (7,500 to 1,500 B.P.)

The Middle Prehistoric period corresponds to a change in climate marked by the Hypsithermal (Chapter 2, Section 2.6.1). This period represents a shift towards broader based subsistence patterns, a transition often linked to climatic and environmental changes; however, large game continued to be a dietary staple (Frison 1976; Reeves 1973).

The Mummy Cave phase (7,300 to 6,700 B.P.) represents the earliest side-notched points found in Alberta (Peck 2011:139). When Reeves (1969:30) initially described this phase, he suggested a time frame of 7,700 to 5, 500 B.P. Dyck (1983:92), suggested that more than one phase was likely represented within the Mummy Cave phase, and instead preferred the term Mummy Cave series. Walker (1992:132-142) identified five different projectile point styles from the Mummy Cave series including Blackwater, Bitterroot, Hawken, Gowen, and Mount Albion. However, Peck (2011:134-135) notes that when projectile point criteria are strictly applied to assemblages, only a handful of sites in Alberta can be considered Mummy Cave. The lack of sites from this period may be attributed to the hot and dry temperatures, which are theorized to have caused a migration of peoples and ecozones to the north where there were lower temperatures and more precipitation (Hurt 1966; Yansa 2006). If this is correct, then it may have brought Plains populations and environments closer to the study area.

Following the Mummy Cave phase, the predominant culture group on the Northern Plains is the Oxbow phase (4,500 to 4,100 B.P.). The Oxbow phase is characterized by a distinctive side-notched projectile point, with a deeply concave base, giving it an "eared" appearance. Oxbow phase technology is similar in form to materials recovered from the Mummy Cave series, which suggests an evolution of the Oxbow culture from Mummy Cave (Reeves 1969; Walker 1992). Numerous sites in Alberta have been classified as containing an Oxbow component, and faunal remains from this period suggest a continued reliance on bison (Peck 2011:181-191). Some archaeologists have suggested that Oxbow-like points found in northern Alberta represent a later movement of people from the Plains into the boreal forest (Spurling and Ball 1981).

The Oxbow phase is overlapped and eventually replaced by the McKean series (4,200 to 3,500 B.P.). The McKean series contains three distinct projectile point styles: McKean, Duncan, and Hanna. On the Northern Plains, McKean sites are not particularly common and may represent an intrusive population (Peck 2011:202). One theory suggests that McKean populations migrated into the region from the foothills of the Rockies (Dyck 1983), and another theory suggests that McKean derived from desert cultures of the Great Basin (Jennings 1957; Mulloy 1954). Subsistence during this time was relatively diverse but still centered mainly on bison.

The McKean series was eventually replaced by the Pelican Lake complex (3,600 to 2,800 B.P.). Two projectile point styles are represented in this complex (Dyck 1983:105). One style has a straight base and sides with corner-notches usually leaving sharp barbs. The other style has straight sides, corner-notches, and a convex base. The origin of Pelican Lake and its relationship to other Middle Period phases is still unclear. Reeves (1983:80) grouped McKean, Hanna, Pelican Lake and the subsequent Avonlea phases into the Tunaxa tradition and suggested that these represent a distinct cultural continuity. Peck (2011:240) argues that the craftsmanship and technological changes seen in the Pelican Lake complex suggest that it is an intrusive culture. However, the commonness of corner-notched projectile points from this time makes it difficult to pinpoint an origin for the Pelican Lake complex (Dyck 1983: 107; Peck 2011:240).

The Besant culture (2,100 to 1,500 B.P.) represents the last phase of the Middle Prehistoric period (Peck 2011:282). This is also the first phase on the Northern Plains to exhibit pottery (Reeves 1983:96). Besant pottery is characterized by conoidal shaped vessels made with grit and/or sand temper and either cord-marked or smooth surface finishes (Walde et al. 1995). Besant projectile points are generally broad, side notched, and have a basal edge that is convex to slightly concave (Dyck 1983). The origins of the Besant culture have been the focus of debate for a number of years. Reeves (1983:185) suggested that the Besant culture was present on the northeastern periphery of the Plains as early as 2,450 B.P. Reeves (1983:189-192) also believed that the Besant people were involved in trade with Hopewell cultures from the south, which allowed for their continued expansion onto the Plains. Others have argued that the evidence does not support this hypothesis (Byrne 1973:436; Vickers 1986:86-87). A theory put forth by Byrne (1973:466) suggests that the Besant phase represented an intrusive culture that first adapted in the boreal forest and then expanded out into the Plains of Manitoba. This viewpoint is supported by Reeves' (1970:174-176) conclusion that Besant projectile points share similarities to materials from the Fisherman Lake sequence (Millar 1968) and the Lockhart River collection (MacNeish 1951) in the Northwest Territories. However, it is also possible that Besant points recovered from the boreal forest represent an entirely different archaeological culture and have been erroneously classified (Cloutier 2004:20).

4.2.1.4 The Middle Prehistoric to Late Prehistoric Transition Period (1,500 to 1,350 B.P.)

According to Peck (2011) the main archaeological culture of the Middle to Late Prehistoric to Late Prehistoric transition period is represented by the Sonota phase (1,500 to 1,350 B.P.). Sonota phase materials are sometimes grouped together as a subset of the Besant phase (Dyck 1983; Reeves 1983; Vickers 1986). However, Neuman (1975) suggested Sonota to be a separate entity from Besant during his work at the Stelzer, Swift Bird, Grover Hand, Arpan, and Boundary Mound sites in South Dakota. The Sonota phase is classified as a mortuary complex and the distinctive trait that separates Besant from Sonota materials is the presence of large burial mounds (Peck 2011; Walde et al. 1995).

4.2.1.5 The Late Period (1,350 to 250 B.P.)

In Alberta the Avonlea phase (1,350 to 1,100 B.P.) marks the beginning of the Late Period. Avonlea materials are widely distributed among the Northern Plains, but are rarely encountered in the parkland, foothills, or mountains of Alberta (Peck 2011:335). The distinctive points of the Avonlea phase are the Avonlea side-notched point and the Head-Smashed-In corner-notched point. Subsistence during the Avonlea phase continued to be largely based on bison.

In Alberta, the Avonlea phase is believed to have transitioned into the Old Women's phase (1,100 to 250 B.P.) (Peck 2011:375). The Old Women's phase is characterized by Cayley Series projectile points, which are small side-notched points, and Saskatchewan Basin pottery (Ives 2006:56; Peck 2011: 403; Peck and Ives 2001). Also, characteristic of the Old Women's phase is the use of *iniskim*, which are ammonite fossils that resemble bison. These fossils have ritual significance for Blackfoot ceremonialists who use them as effigies. The recovery of ammonites, amongst several forms of evidence, links the Old Women's phase and the Blackfoot (Peck 2002; Vickers 1986; Vickers and Peck 2009).

4.2.2 The Barrenlands (Northwest Territories)

The archaeological sequence of the Northwest Territories (NWT) that is most pertinent to studies in northern Alberta is that of the Barrenlands in the central District of Mackenzie (Gordon 1975, 1996). Also relevant are sequences from Fisherman Lake and Fort Liard (MacNeish 1954; Millar 1968, 1981). Richard MacNeish first surveyed this region and adjacent areas of the Yukon and northernmost British Columbia in 1949 (Clark and Morlan 1982; MacNeish 1951). A speculative framework of the culture history for the region was described by MacNeish, but is now mostly disregarded (Clark 1987:145; MacNeish 1959). Based on four seasons of research, Noble (1971) developed a cultural sequence which contained three archaeological traditions and 19 phases. Later research has built on but largely overridden Noble's various complexes; notably, Gordon (1996) developed Noble's discussion of the Taltheilei Shale tradition. Gordon (1996) has also presented the most recently produced culture history of the Barrenlands. Much of his work has been concerned with the dependence of Barrenland archaeological cultures on migratory herds of caribou (Gordon 1975, 1996). As a result, Gordon has been interested in how climate change has driven fluctuations of the northern treeline, altering favourable caribou calving and foraging locations and therefore impacting caribou-human interaction locations among caribou-dependent Barrenland groups (Gordon 1976:31). At certain periods, the southward movement of the treeline may have brought these caribou hunting cultures into Alberta, Saskatchewan, and Manitoba. The traditions proposed by Gordon (1996) for the Barrenlands region include:

- Northern Plano (8,000 to 7,000 B.P.)
- Shield Archaic (6,500 to 3,500 B.P.)
- Pre-Dorset (3,450 to 2,650 B.P.)
- Taltheilei (2,400 to 200 B.P.)

4.2.2.1 The Northern Plano Tradition (8,000 to 7,000 B.P.)

The Northern Plano tradition described by Gordon (1996:219), and various others, is typically associated with Agate Basin-like projectile points. According to Peck (2011:55), Agate Basin-type points in the Northern Plains date between 10,200 to 9,000 B.P. (Section 4.2.1.1). However, points with Agate Basin affinities recovered in Barrenlands contexts frequently yield dates between 8,000 and 7,000 B.P., which implies a continuation or later arrival of this point style in the north. These points are typically basally tapered, and biconvex with ground, stemmed bases (Gordon 1996:221). According to Gordon (1996:234) Northern Plano artifacts are widespread because the treeline expanded farther north due to the warm post-glacial climate. However, most researchers argue that the treeline reached its furthest northern extent during the Hypsithermal and not in the immediate post-glacial times (Strong et al. 2005).

Noble (1971:104) recovered Northern Plano materials at Acasta Lake. Here a total of 33 Agate Basin-like projectile points were recovered along with 532 bifaces, 368 scrapers, and 105 pit-hearths. A radiocarbon date from a piece of charcoal associated with one of the hearths produced a date of 7,020 ± 320 B.P. (Noble 1971:106). At the Migod site, Gordon (1976) obtained a radiocarbon date of 7980 ± 500 B.P. from a layer overlying Agate Basin-like material. Northern Plano artifacts have also been recovered in the southwest District of Mackenzie at Fisherman Lake (MacNeish 1954; Millar 1968, 1981), and at the nearby Julian site (Fedirchuk 1970:28). Wright (1972:85-86) has argued that Northern Plano cultures evolved into Shield Archaic.

4.2.2.2 The Shield Archaic Tradition (6,500 to 3,500 B.P.)

Shield Archaic cultures occupied the Barrenlands region during the Hypsithermal (Chapter 2, Section 2.6.1), starting around 6,500 years ago (Gordon 1996:199). Side-notched projectile points, end scrapers, bifacial and unifacial knives, wedges and chi-thos characterize Shield Archaic sites (Meyer 1983:149; Wright 1981).

Gordon (1996:201) has divided this tradition into Early, Middle, and Late phases based on point styles and radiocarbon dates. The Early Shield Archaic phase occurs between 6,450 and 5,450 B.P., the Middle phase spans 5,450 to 4,450 B.P., and the Late phase is represented by dates of 4,450 to 3,500 B.P. The Early Shield Archaic tradition is only represented by a single side-notched projectile point recovered from the Warden's Grove site (KjNb-7) and several radiocarbon dates (Gordon 1996:201). Middle Shield Archaic materials are represented by long notched projectile points, while Late phase material is identified by small notched projectile points (Gordon 1996:201).

The Late Shield Archaic coincided with a period of climatic deterioration which caused the treeline to move further south. Gordon postulates that this led to the movement of Shield Archaic people into the boreal forest of northern Saskatchewan, Manitoba, and possibly Alberta (Gordon 1996). Gordon (1996:201,203) notes that Late Shield Archaic materials have been found in association with McKean-Duncan point styles, which may suggest contact with Plains Archaic hunters.

4.2.2.3 The Pre-Dorset Tradition (3,450 to 2,650 B.P.)

The Pre-Dorset tradition is an early Eastern Arctic expression of the Arctic Small Tool Tradition (ASTt), which originated in the High Arctic over 4,000 years ago (Gordon 1996:149; McGhee 1972; Knuth 1958; Maxwell 1976). At approximately 3,500 B.P., maritime hunting was affected by a prolonged cold period. It has been postulated that the southern migration of Shield Archaic people during this time allowed for Pre-Dorset peoples to move further south, with some groups eventually developing linkages to migrating caribou herds in the Barrengrounds. Gordon (1996:149) has argued that the cold environment during this period pushed the treeline southward and Pre-Dorset people who wintered in the forest made it as far south as Alberta, Saskatchewan, and Manitoba (Clark 1987:153; Ives 1991:11-12; Nash 1969; Wright 1975:131).

Distinguishing characteristics of the Pre-Dorset tradition are small, carefully knapped bi-pointed and triangular projectile points, semi-lunar side blades, burins, and microblade technology (Meyer 1983:149; Gordon 1975:108). Noble (1971:107-110) defined four sequent complexes from this period including Rocknest Lake (3,150 to 2,850 B.P.), Aurora River (2,850 to 2,650 B.P.), Timber Point (2,650 to 2,350 B.P.), and MacKinlay River (2,350 to 2,150 B.P.). However, none of these phases had any associated radiocarbon dates and were defined on the basis of typological comparisons and relative beachline chronologies (Noble 1971:108). Noble (1971:110) suggested that artifacts characteristic of the MacKinlay River phase showed similarities to both Pre-Dorset and the succeeding Taltheilei tradition, which he attributed to an admixture of inland formerly Arctic cultures with a forest-adapted people. Gordon (1975:95) rejects this notion on the basis of sites excavated along the Thelon River, which have undisturbed Pre-Dorset materials that underlie undisturbed Taltheilei materials, with no apparent mixing between the two traditions.

4.2.2.4 The Taltheilei Tradition (2,400 to 200 B.P.)

Noble's (1971:111) Taltheilei Shale tradition initially consisted of 10 different complexes; Hennessey, Taltheilei, Windy Point, Waldron River, Narrows, Lockhart, Frank Channel, Fairchild Bay, Snare River and Reliance. Gordon (1975, 1976, 1981, 1996) later refined this tradition and grouped it into three cultural phases; Early, Middle and Late Taltheilei.

Early Taltheilei dates between 2,450 and 1,800 years B.P. Gordon (1996:115) believes that the first Taltheilei people travelled into the Barrenlands via the Peace River; however, he does not have any clear evidence to support this claim other than the fact that the Early Taltheilei people were already well adapted to the forest. Projectile points from this period have a thick, narrow body with a shouldered and ground base (Gordon 1981:11). The Middle Taltheilei phase dates between 1,800 to 1,300 years B.P. Projectile points from this period lose their shoulders and develop into diamond-shaped and lanceolate specimens with bodies that taper towards the tip and base (Gordon 1981:13). The Late Taltheilei phase dates between 1,300 to 200 years ago. Gordon suggests that Late Taltheilei cultures acquired bow and arrow technologies from the Plains and therefore projectile points and notching techniques vary more than the earlier phases (Gordon 1996). Points from this period differ in size and some are corner and side notched while others are stemmed (Gordon 1996:59). Morrison (1984:199) has suggested that some Late Taltheilei materials resemble some Plains side-notched points, which may indicate a cultural influence or borrowing from Northern Plains cultures.

Between 700 to 300 years ago Gordon postulates that the people of the Late Taltheilei were forced into the forests in the southern portion of their range due to a cooling period known as the Little Ice Age (Gordon 1996:55). Gordon (1996:239) suggests that these people were the last of the caribou herd followers. The descendants of the Taltheilei are traditionally seen as ancestral to the historic Dene, who in the Historic period were enticed to move to the south to follow the fur trade. The Caribou Inuit occupied the Barrengrounds areas opened up by these movements, pushing south towards the treeline in the early to mid-1800s; however, they did not follow the caribou migration cycle because the Dene fur trappers prevented them from living in the caribous' boreal forest winter range (Gordon 1996:240).

4.2.2.5 The Northwest Microblade Tradition / Denali Tradition (13,000 to 3,000 B.P.)

Nelson (1935, 1937) was the first to draw attention to a unique microblade tradition in North America, when he noted similarities between microblade industries from the Campus site in Alaska and artifacts recovered in East Asia. MacNeish also observed similarities in finds of microblade assemblages between the Campus site and the Pointed Mountain site in the NWT and proposed that there was a "distinctive cultural pattern" over much of the Western Subarctic (MacNeish 1954:252). The most distinctive element of this cultural pattern is the association of these microblades with wedge-shaped cores, crudely made burins, chi-thos, and endscrapers (Clark 2001; Clark and Gotthardt 1999; MacNeish 1964). MacNeish named this pattern the Northwest Microblade tradition (NWMt) and suggested that it was passed down through diffusion and migration to a number of archaeological cultures over a temporal span of roughly 9,000 years (Clark 1987; Clark and Gotthardt 1999; MacNeish 1959, 1962).

However, West (1967:374) concluded that "the concept of a Northwest Microblade tradition should be applied cautiously, if at all", and suggested that its only virtue was to group microblade industries that were not assignable to the ASTt. West (1967) instead drew on assemblages from Alaska to formulate an early core and blade culture, known as the Denali tradition which is characterized by wedge-shaped Campus cores and Donnelly burins. Subsequent research in Alaska has confirmed an early date for the Denali tradition of 13,000 B.P.; however, some sites with artifacts attributed to the Denali tradition have also produced a much more recent date of 3,000 B.P. (Clark 2001:73). Millar's (1981) work at the Pointed Mountain site led him to the conclusion that artifacts associated with the Denali tradition are actually an early phase of the NWMt. Other archaeologists have split the Denali tradition into early and late phases (Bacon 1987; Dixon 1985).

Clark (2001:77) suggests that, in Canada, we should postpone conclusions about Denali/late Denali classifications until there are better data and we should instead continue to use the NWMt. In the Barrenlands, dates for NWMt tend to be younger than in Alaska/Yukon. The NWMt identified at the Pointed Mountain site dates to 4,200 B.P. (Clark 2001:76; Millar 1981) and at the Qugyuk site Le Blanc identified both ASTt and NWMt occupations with the latter dating between 3,900 to 4,300 B.P. (Le Blanc 1994). Clark and Gottardt (1999:175) suggest that the south eastward spread of the NWMt into Canada began in the Yukon about 7,000 to 8,000 years ago with a further, and later, spread into the District of Mackenzie and adjacent areas of British Columbia and Alberta.

4.2.3 Northeastern Saskatchewan

The prehistory of the Saskatchewan boreal forest is still not fully understood, as many of the same issues afflict it as northern Alberta (Section 1.2). Limited stratigraphy and a lack of research make it difficult to piece together a complete cultural chronology of the area. However, significant research has taken place along the Upper Churchill River Basin (Millar 1997), as well as at Black Lake (Minni 1975) and Lake Athabasca (Wright 1975). Meyer (1983, 2007; Meyer and Russell 2007) has written extensively about the cultural sequence of northern Saskatchewan as it is currently understood. Throughout prehistory, northern Saskatchewan has been divided between two groups; Barrenland caribou hunters in the northern forest-tundra transition zone and less specialized hunters in the coniferous and mixed wood forests to the south (Meyer 1983:141). Meyer and Russell (2007) have divided the prehistory of northern Saskatchewan into three main periods:

- The Plano Period (10,200 to 7,500 B.P.)
- The Middle Period (7,500 to 2,000 B.P.)
- The Late Period (2,000 to 300 B.P.)

4.2.3.1 The Plano Period (10,200 to 7,500 B.P.)

The Plano period in Saskatchewan is best represented in the southern and central portions of the province and dates to as early as 10,200 B.P. (Meyer and Russell 2007:105). At the beginning of this period, the glaciers in northern Saskatchewan had begun to recede and the newly exposed environment consisted of raging meltwaters and glacial lakes (Meyer 2007).

Beginning about 9,000 B.P. the climate began to become progressively milder and drier, which allowed the grasslands to advance northwards. By late Plano times, about 8,000 B.P., only the extreme northeastern portion of Saskatchewan was covered by glacial ice. At this time migratory herds of caribou from the northern Barrenlands began to move seasonally between the winter ranges in northern Saskatchewan and Manitoba and summer ranges in the Northwest Territories (Meyer and Russell 2007:105). During this period, a Northern Plano phase represented by Agate Basin-like projectile points had clearly become well established in northern Saskatchewan (Meyer 2007; Meyer and Russell 2007:105; Meyer and Walker 1999:20). In addition to Agate Basin projectile points, artifacts representative of the Cody tradition have also been recovered in the Upper Churchill Basin (Meyer 2007; Millar 1997:104-106). On the Plains, the people who produced the Agate Basin and Cody tradition materials were avid bison hunters. The initial movement of these people toward the Upper Churchill basin may reflect the continued warming in post-glacial times that allowed them to follow grasslands and bison as they expanded north of their previous limits (Meyer 2007). However, by the end of this period Northern Plano peoples had become well-established throughout northern Saskatchewan once they were able to develop an economy focused on hunting Barrenland caribou (Meyer 2007; Meyer and Russell 2007).

4.2.3.2 The Middle Period (7,500 to 2,000 B.P.)

The Middle period in the Saskatchewan boreal forest is still poorly understood; however, it is characterized by a series of side- and corner-notched projectile points that are stylistically similar to both artifacts found in the Northern Plains to the south, and to artifacts recovered from the Barrenlands to the north. Meyer and Russell (2007) suggest that the Middle Period in northern Saskatchewan was strongly influenced by Plains cultures including Mummy Cave, Oxbow, McKean, and Pelican Lake. Oxbow and Pelican Lake point styles have also been recovered as far north as the central District of Mackenzie (Noble 1971); however, the identification of these point types tends to be made from stylistic comparisons, often by archaeologists trained in Northern Plains typologies (Martindale 2014). Therefore, there is potential that some of these point types have been misidentified. For instance, when Wright (1975) surveyed both the Saskatchewan and Alberta sides of Lake Athabasca, he suggested that the western half of the lake was occupied by Northern Plains hunter and gatherers, while the eastern half of the lake was occupied by boreal forest caribou-hunting societies. However, Donahue (1976:122) disagreed with Wright about the affiliation of some of the Northern Plains projectile points, which he instead believed to be comparable to Late Taltheilei materials. This disagreement highlights the difficult nature of placing artifacts into diagnostic groupings based on morphology alone. It also highlights the fact that many Middle Period projectile points from the Northern Plains may be similar in style to Late Period Taltheilei materials.

By 5,000 B.P., the climate was cooler with higher precipitation and by 3,000 B.P., the boreal forest had advanced southward to its current position (Meyer and Russell 2007:107). The cooling climate encouraged the displacement of northern groups further south and by approximately 3,500 B.P., Pre-Dorset cultures had moved into the area (Gordon 1975, 1996; Meyer and Russell 2007). The appearance of Pre-Dorset groups in northern Saskatchewan has been hypothesized to have a direct relationship to the winter foraging area of Barrengrounds caribou herds (Minni 1976:52; Gordon 1975). In Saskatchewan, Pre-Dorset materials have been recovered around Lake Athabasca (Wright 1975), Black Lake (Minni 1976), and as far south as Reindeer Lake (Meyer and Russell 2007:107).

4.2.3.3 The Late Period (2,000 to 300 B.P.)

By 2,450 B.P., the Taltheilei culture had become well-established in the tundra to the north where they lived as caribou herd followers (Section 4.2.2.4). By 2,000 B.P. some Taltheilei groups expanded southward into the boreal forest of Saskatchewan and remained in place well into the Late period. The southernmost limit of the Taltheilei culture in Saskatchewan is marked by the Churchill River system, which also corresponds with the extreme southern migration limit of Barrenland caribou (Young 2006:13).

By 1,450 B.P., the Laurel culture, which had ties to the eastern woodlands, arrived in northeastern Saskatchewan (Meyer 2007; Meyer and Russell 2007:107). The Laurel culture was characterized by an elaborately decorated conoidal pottery (Meyer and Russell 2007:108). At 950 B.P. another eastern woodland ceramic producing culture known as Blackduck appeared in northeastern Saskatchewan. However, neither of these cultural groups expanded into northwestern Saskatchewan (Meyer 1995:56).

At around 550 B.P., a third ceramic producing group, the Selkirk culture, developed throughout the forest region. The Selkirk culture is believed to have developed as an amalgamation of Laurel and Blackduck groups and extended into northwestern Saskatchewan and northeastern Alberta (Meyer 1995:57; Meyer and Russell 1987:21-25; Young 2006). MacNeish (1958:67-71) was the first to identify and define the Selkirk culture, which is characterized by small side notched projectile points and globular pottery vessels made inside fabric bags. Since that time, there have been attempts to define a number of cultural phases/complexes that are Selkirk-related including the Kisis phase (Millar 1983) and the Buffalo Lake phase (Young 2006). The Kisis phase is characterized by pottery vessels described as Clearwater Lake Punctate, and the Buffalo Lake phase is characterized by Narrows Fabric-impressed ware. Meyer (2013) proposes that the Buffalo Lake culture was ancestral to Woodland Assiniboine groups. The Selkirk culture disappeared approximately 300 B.P. with the introduction of the fur trade (Meyer 2007).

4.2.4 Northeastern British Columbia

The archaeological record of northeastern British Columbia has seen limited efforts at the synthesis of a culture history; however, archaeological understanding of the region's archaeological sequence has been greatly enhanced by excavations at the Charlie Lake Cave site, near Fort St. John (Driver et al 1996; Fladmark 1996; Fladmark et al. 1988). The assemblage from Charlie Lake Cave is particularly important to the study area due to its location on the Peace River, which connects directly to northern Alberta. Stratified deposits from the site span the last 10,500 years and have significantly enhanced our knowledge of the prehistory of northeastern British Columbia. Generally, the artifacts recovered from Charlie Lake Cave are insufficient to allow confident statements or comparisons to neighboring regions, especially as the Charlie Lake Cave assemblage largely lacks diagnostic items, which allow stylistic and technological characteristics and relationships to be explored (Driver et al. 1996:276). However, Howe and Brolly (2008) have proposed an initial projectile point sequence for northern British Columbia using the research at Charlie Lake Cave in conjunction with data collected at multiple other sites in advance of hydroelectric and oil and gas developments. Driver et al. (1996:270) define ten cultural components at Charlie Lake Cave based on the site's stratigraphy, rather than on the nature of its artifacts. These cultural components can be grouped into three distinct periods:

- The Early Prehistoric Period (10,500 to 7,000 B.P.)
- The Middle Prehistoric Period (7,000 to 4,300 B.P.),
- The Late Prehistoric period (1,500 to 300 B.P.)

4.2.4.1 The Early Prehistoric Period (10,500 to 7,000 B.P.)

The Early Prehistoric period in northeastern British Columbia is best represented by components 1 through 3 at the Charlie Lake Cave site (Driver et al. 1996:270-272). Component 1 dates to approximately 10,500 B.P. and is associated with butchered bison bones and a complete Clovis projectile point (Driver et al. 1996:270-271). This projectile point remains the only dated fluted point in northwestern Canada to be found in situ with faunal materials (Fladmark 1996; Driver et al. 1996; Howe and Brolly 2008). The point appears to have been heavily re-sharpened, and was potentially reused as a knife (Fladmark 1996). Component 2 at Charlie Lake Cave dates to 9,850 B.P. However, it contains no diagnostic artifacts (Driver et al. 1996:272).

Component 3 has been dated to 9,500 B.P. and contains an articulated raven skeleton found in association with one microblade core. Driver et al. (1996) note that the microblade core resembles the wedge-shaped cores of Alaska, suggesting a NWMt/Denali association (Section 4.2.2.5). This affiliation does have some uncertainty; the core has been described as being unifacially flaked with poor platform preparation (Driver et al 1996:272; Fladmark 1996:11). It also lacks the sharp keel seen on most wedge-shaped specimens from the NWMt (Driver et al. 1996:272). In other portions of British Columbia, wedge-shaped unifacial microblade cores with poor platform preparation have been attributed to the Plateau Microblade tradition, first described by Sanger (1968); however, artifacts from this tradition are more commonly associated with the Middle Prehistoric Period (Pokotylo and Mitchell 1998:95). The radiocarbon date associated with the Charlie Lake Cave microblade is coeval with the Denali tradition. Unfortunately, it is difficult to evaluate a single microblade core in terms of technological traditions.

In addition to the Charlie Lake Cave site, the Pink Mountain site in northern British Columbia has been recognized as containing Early Prehistoric materials (Wilson 1989, 1996). Surface finds of fluted points in this area had been noted in private collections (Fladmark 1981). In 1986, Wilson (1989, 1996) surveyed a 1-km-long road cut exposure. The bases of two fluted points were recovered, both resembling the fluted point from Charlie Lake Cave (Wilson 1996). Furthermore, Wilson (1989, 1996) recovered a single undated Scottsbluff point. The following year, Wilson and Carlson (1987) returned to the area in order to examine other road exposures and private collections. Ten new sites were recorded, three of which included points identified as resembling Alberta and Agate Basin types. Because the points did not come from a dated context it is difficult to interpret whether or not the Agate Basin materials are contemporaneous with those found in the Northern Plains (Section 4.2.1.1.) or if they are associated with a slightly more recent date, like Northern Plano materials recovered in the NWT (Section 4.2.2.1). A cultural resource management consultant working in advance of a proposed oil and gas development conducted the most recent research near Pink Mountain, in 2015. This work resulted in the recovery of another fluted Clovis projectile point (Britten 2016). Further research in the Pink Mountain area may give us better insight into the early period in northeastern British Columbia.

4.2.4.2 The Middle Prehistoric Period (7,000 to 4,300 B.P.)

Driver et al. (1996) identify the Middle Prehistoric period at Charlie Lake Cave with components dating between 7,000 to 4,300 B.P. A single side-notched projectile point with basal thinning was recovered from component 5 (7,000 to 5,000 B.P.). Driver et al. (1996:273) note that this point is stylistically similar to a point recovered at the nearby Farrell Creek site (HaRk-1), where associated organic material radiocarbon dated to 4,400 B.P. (Spurling 1980). The point is also like specimens recovered in the central District of Mackenzie, at Acasta Lake (Noble 1971) and Pointed Mountain (Millar 1968).

Component 6 has been dated to 4,500 B.P. The artifacts from this component include a well-made side-notched projectile point and a single chert microblade fragment (Driver et al 1996; Fladmark 1996). Similar projectile points have been found in northwestern Alberta at HbRb-17 (Spurling 1980) and the Karpinsky site (GkQn-1) (Bryan and Conaty 1975). It is difficult to determine a cultural affiliation for the microblade; as noted previously (Section 4.2.2.5) the NWMt spans a period between 13,000 and 3,000 years B.P. Another microblade tradition in northern British Columbia is the Ice Mountain tradition, initially described by Smith (1971, 1974). This tradition was defined based on an assemblage from Mount Edziza, which Fladmark (1985) proposes dates between 5,000 and 4,000 B.P. While it is difficult to identify the cultural affiliation of the microblade from Charlie Lake, it does fall into the correct timeline to fit within this tradition.

Component 7 contains three large side-notched, concave-based projectile points and one fragment of a corner-notched point that date to 4,300 B.P. (Driver et al. 1996:273). The larger points from this component share similarities with Oxbow points found in the Northern Plains. Spurling and Ball (1981) hypothesized that Oxbow points in the Peace River district represent a movement of Northern Plains people into the boreal forest and that a general decrease in the age of such artifacts should be seen with more northern latitudes. According to their conclusions, Oxbow-like points in the Peace River district should fall in the 3,000 to 2,500 B.P. range; however, the point from Charlie Lake Cave appears to refute this hypothesis (Driver et al. 1996:273).

4.2.4.3 The Late Prehistoric Period (1,500 B.P. to 300 B.P.)

The Late period of Charlie Lake Cave consists of components 8 through 10. Component 8 dates to 1,500 B.P. and consists of two small projectile points with shallow side notches and convex bases (Driver et al 1996:274). Components 9 and 10 postdate 1,500 B.P. and contain three projectile point styles. Driver et al. (1996:274) note that two of these specimens are similar in style to points found within the Taltheilei tradition. If this proves true, then it may give some credibility to Gordon's hypothesis that the Taltheilei tradition moved into the Barrengrounds through the Peace River (Section 4.2.2.4). The other two point styles consist of two small side-notched projectile points and one small corner-notched point that are similar in style to arrowheads found throughout North America dating to within the last 1000 years.

4.3 Culture Chronology of Northeastern Alberta

Donahue (1976:119-130) provided one of the first general descriptions of human prehistory in northern Alberta. At the time, very little research had been conducted in the region and as a result he relied heavily on evidence from the NWT and Northern Plains.
Ives (1993) subsequently presented a more detailed chronology. Ives stressed the difficulties of laying out a comprehensive cultural framework for northern Alberta, and provided a general outline of the Early, Middle, and Late Pre-contact periods. The influx of archaeological research in the oil sands region allowed Ives (2017) to add to his previous work; however, he was still hesitant to assign phase or complex designations due to the difficult circumstances presented by the boreal forest environment (Chapter 1, Section 1.2). Based on sites discovered in advance of Syncrude's Aurora North Project, Saxberg and Reeves (2003) developed an early cultural sequence that spanned 9,900 to 7,000 B.P. At the time their paper was written, the authors believed that large lanceolate points of various types occurred at higher elevations along what would have been ancient shorelines created by the floodwaters of glacial Lake Agassiz. Progressively later points were assumed to occur at lower elevations and were exposed as these flood waters retreated. Reeves et al. (2017) expanded upon this work by analyzing a large

number of artifacts recovered through both academic research and cultural resource management. The result was a detailed and comprehensive cultural sequence that spanned the entire history of the oil sands region. However, without independent radiocarbon dating it is impossible to confirm the validity of this chronology. Still, for the purposes of this study, the dates provided for the periods in Northern Alberta will be as follows:

- The Paleoindian Period (11,500 to 10,200 B.P.)
- The Early Period (10,200 to 7,000 B.P.)
- The Middle Period (7,000 to 2,500 B.P.)
- The Late Period (2,500 to 300 B.P.)

4.3.1 The Paleoindian Period (11,500 to 10,200 B.P.)

Sediment cores collected from the Caribou and Birch Mountains suggest that deglaciation of the region began between 11,000 to 12,000 years B.P. (Ives 1993:5; Chapter 2, Section 2.3). This is contemporary with the time that fluted point technologies were being utilized in other parts of North America (Section 4.2.1.1). To date, no fluted points have been recovered in the Birch Mountains or lower Athabasca region.

Further to the south, at the Duckett site (GdOo-16), a single stubby Clovis point was surface collected on the shores of Ethel Lake (Fedirchuk and McCullough 1992). This point is of particular interest because it was identified as having been fashioned out of Beaver River Sandstone (BRS) (Fedirchuk and McCullough 1992:130). The presence of this raw material implies that its maker visited or otherwise had access to the BRS source location in the lower Athabasca (Chapter 3, Section 3.2.2). However, Ives (1993:26) mentions that Tongue River silicified sediment, found in Montana, is macroscopically indistinguishable from BRS and therefore, "it would be imprudent to insist that isolated examples of Paleo-Indian point styles made from raw materials like Beaver River Sandstone have any necessary connection with the lower Athabasca River valley". Therefore, it remains uncertain whether groups in the lower Athabasca and Birch Mountain study area utilized fluted point technologies, but the possibility does exist.

Further, evidence for an early occupation of the study region may be present in materials recovered at Eaglenest Portage and Gardiner Lake. Ives (2017:295) notes that one oblanceolate biface from Eaglenest Portage (see Ives 2017, Figure 8.3a) and two bifaces from Gardiner Lake Narrows (see Ives 2017, Figure 8.3b and c) are similar to bifaces recovered from Component II in Dry Creek, Alaska (see Powers and Hoffecker 1989, Figure 6c). In both cases, the bases of the specimens remain unflaked and feature “an unaltered ellipsoidal facet or flake scar” (Ives 2017:295). The Eaglenest Portage biface is also noticeably thick, in a similar manner to the biface discovered at Dry Creek (Ives 2017:295; Powers and Hoffecker 1989). The Dry Creek Component II materials are associated with the Denali tradition and have been radiocarbon dated between 10,690 to 10,000 B.P. (Ives 2017:295; Powers and Hoffecker 1989). If the biface recovered from Eaglenest Portage is related to the Dry Creek materials, it may point to an early occupation of the Birch Mountain study area; however, without radiocarbon dates it is impossible to say.

Evidence of fluted point technology has been noted in areas adjacent to the study area. For instance, in the Peace River district of northwestern Alberta surface disturbance from cultivation revealed a concentration of fluted points (Gryba 1988). A series of macroblades reworked into blade tools also exist in private collections from this region. Le Blanc and Wright (1990) suggest that these blades exhibit similarities to Clovis blades from Blackwater Draw and to a single macroblade recovered by Millar (1981) near Fisherman Lake in the NWT. This blade, which was subsequently reworked into a projectile point, was originally classified by Millar (1981) as belonging to the Northern Plano tradition. Le Blanc and Wright (1990) suggest that although the macroblades seen in the Peace River district come from undated contexts, they may have affiliations with both Clovis and Plano period assemblages.

Additionally, Bereziuk (2001) found a fluted projectile point base at the Smuland Creek site, near Grande Prairie. Unfortunately, this point had no associated radiocarbon dates. It was found alongside a flake graver and ten pieces of debitage, all of which were found only in the upper 15 cm of the profile. Bereziuk (2001:388) describes the point base as slightly concave and parallel with excurvate lateral edges suggestive of a lanceolate shape. It does not exhibit a deeply indented base such as the fluted point from Charlie Lake Cave (Section 4.2.4.1). One of the debitage pieces recovered from the site was described by Bereziuk (2001) as Tertiary Hills Clinker, which can be sourced to the NWT (Section 4.2). The implication is that the site’s occupants were either travelling to or trading with groups from the north.

4.3.2 The Early Period (10,200 to 7,000 B.P.)

Elongated lanceolate and stemmed projectile points of varying styles characterize the Early Period in northern Alberta. Artifacts post-dating 9,000 B.P. are thought to be the most common and this may represent a repopulation of the area after a hiatus due to the Agassiz flood (Reeves and Saxberg 2003; Section 2.3.1). Human groups would have had the opportunity to enter into the study area by following animal species whose territory had expanded into the region. Evidence for this is seen in Agate Basin materials recovered in northern Alberta and Saskatchewan (Section 4.2.3.1). One specimen worth noting is a lanceolate projectile point made of Tertiary Hills Clinker which was recovered at the Gardiner Lake Narrows site (Ives 1993:9). Another artifact was a point recovered from the Beaver Creek Quarry site (Ives 1993:9). These points are stylistically similar to Agate Basin projectile points found on the Northern Plains, which date as early as 10,200 B.P. (Section 4.2.1.1), and also to Northern Plano points in the Barrenlands, which can date to as late as 7,000 B.P. (Section 4.2.2.1). The possibility exists that northern Alberta saw an influx of northward travelling groups who utilized these point types shortly after the Agassiz flood, around 9,500 to 8,000 years B.P. Caribou-hunting Northern Plano groups from the Barrenlands may have continued to move in and out of the study region between 8,000 to 7,000 B.P.

Saxberg and Reeves (2003) and Reeves et al. (2017) have grouped lanceolate and stemmed projectile points which they have assigned to this period into a series of complexes. The earliest of these, the Fort Creek Fen complex (9,900 to 9,400 B.P.), is characterized by thin lanceolate projectile points which Reeves and colleagues believe are similar to points recovered from Wyoming and Montana. Some Fort Creek Fen materials also display a flared base, such as those illustrated in Reeves et al. (2017, Plate 6.1). An elongated specimen with a similar flared base was recovered from the Karpinsky site and has an associated radiocarbon date of only 1070 ± 55 B.P. (Bryan and Conaty 1975, Plate 3a). A projectile point from the Eaglenest Portage site also displays a flared base; however, it has no associated radiocarbon dates (Figure 4.3). Donahue (1976:128) suggests that the Karpinsky assemblage is reminiscent of artifacts recovered from central British Columbia.

Figure 4.3 Projectile point with a flared base recovered from the Eaglenest Portage site.

According to Reeves et al. (2017: 166), microblade technology is present within Fort Creek Fen assemblages. The authors describe “wedge-boat-shaped” microblade cores, which are compared to cores from the Ice Mountain tradition in northern British Columbia (Fladmark 1985; Smith 1971, 1974; Section 4.2.4.2). However, the Ice Mountain tradition is believed to date between 4,000 and 5,000 B.P., which is significantly later than the dates proposed for the Fort Creek Fen complex (Fladmark 1985; Reeves et al. 2017:164). The possibility of microblades existing during this early time period in northern Alberta is a reasonable assumption, given evidence for early microblades in nearby regions (Le Blanc and Ives 1986; Wilson et al. 2011; Younie et al. 2010:91). The earliest indication of microblade technology in Alberta is from Vermilion Lakes in Banff National Park, where a microcore was recovered in a context dated to just a little before 10,000 B.P. (Le Blanc 2004:138). This could point to the possibility that NWMt material penetrated into Alberta at an early date; however, it also may have originated from early microblade cultures known in the west, on the coast of British Columbia. As Le Blanc (2004:138) points out, “the data … are too far sketchy for anything but speculation”.

Reeves et al. (2017:166) argue that the Fort Creek Fen complex transitioned into the Nezu complex (9,400 to 8,500 B.P.), which is characterized by Northern Plano (Section 4.2.2.1) and Cody tradition materials (Section 4.2.1.1). According to Reeves et al. (2017:184) and Ives (1993, Figure 2d) Scottsbluff and Alberta points have been recovered from the study area. The Creeburn Lake complex (8,600 to 7,750 B.P.) which is associated with Agate Basin- and Lusk-like projectile points, follows the Nezu complex. Side- and corner-notched projectile points follow in the early Beaver River complex (7,750 to 7,000 B.P.).

It should be noted that artifacts belonging to these complexes can be hard to identify from stylistic/morphological comparisons alone, and as no radiocarbon dates have been obtained for these various complexes, it is difficult to establish a secure chronological footing. Materials recovered from the Karpinsky site (Bryan and Conaty 1975) demonstrate the difficult nature of assigning complex or phase designations to projectile points based on style alone. Here, a series of stemmed and elongated projectile points, which could easily be confused with early materials, were recovered with an associated radiocarbon date of 1070 ± 55 B.P (Bryan and Conaty 1975:68). Many Early and Middle period Taltheilei artifacts (Section 4.2.2.4) display highly similar traits to Early period lanceolate and stemmed projectile points. To further confuse the situation, large side- and corner-notched projectile points, such as those attributed to the Beaver River complex, can be difficult to discriminate from large notched, Late Taltheilei materials. A more detailed analysis of these complexes will be needed when diagnostic artifacts are recovered from stratified sites with associated radiocarbon dates, or when effective spatial analytical techniques can be applied in association with radiocarbon dates to help ensure their validity.

4.3.3 The Middle Period (7,000 to 2,500 B.P.)

The Middle Period in northern Alberta is represented by a series of side- and corner-notched projectile points. Some of these point styles may represent evidence of hunters moving into the region from the adjacent Northern Plains and Barrenland regions. Points with Oxbow, McKean, and Pelican Lake affinities have been identified throughout northern Alberta (Gruhn 1981; McCullough 1982; Pollock 1978; Conaty 1977). Influences from the Barrenland region include artifacts that are reminiscent of Sheild Archaic, NWMt, and Pre-Dorset materials (Reeves et al. 2017; Le Blanc and Ives 1986; Ives 1993). Changing vegetation patterns throughout the Middle Period, caused by changing climatic conditions, could have facilitated a movement of people into the study area from these adjacent regions. Le Blanc (2004:139) notes that it is equally as plausible that point types moved into the area without people, “diffusing in some fashion via intergroup contact or trade", and that Plains-like points recovered in the boreal forest are actually local derivatives of Plains types seen in the south.

Reeves et al. (2017) view the beginning of this period as a continuation of the Beaver River complex, which is characterized by side- and corner-notched points that show similarities to points from the Mummy Cave tradition and Oxbow phase in the Plains (Section 4.2.1.3), and to Shield Archaic sites from the NWT (Section 4.2.2.2). Ives (1993, Figure 4) illustrates a number of projectile points found in northern Alberta that share the distinctive "eared" appearance characteristic of Oxbow material. According to Ives (1993:11), in northwestern interior North America, points of this variety can range in age between 5,500 to 2,500 years ago. Spurling and Ball (1980) argue that points with Oxbow affinities in the boreal forest represent a later movement of people from the Plains into the forest region. However, Oxbow-like points recovered from Charlie Lake Cave date to 4,300 B.P. (Section 4.2.4.2). Unfortunately, there is insufficient data available in order to document the age of Oxbow points recovered in northeastern Alberta, as none have been recovered in a dated context.

Reeves et al. (2017) consider the Firebag Hills complex (4,000 to 2,650 B.P.) to be representative of the latter portion of the Middle period. According to Reeves and colleagues, the Firebag Hills complex is a southward extension of Pre-Dorset (Section 4.2.2.3) cultures into Alberta and Saskatchewan. Pre-Dorset materials have been recovered in the Birch Mountains at the Satsi site (Ives 1993:11-12), along the shores of Lake Athabasca (Wright 1975), and at sites in northern Saskatchewan (Minni 1976; Meyer and Russell 2007; Section 4.2.3.2). A radiocarbon date taken from a smudge pit discovered at the Satsi site gave a date of 2,795 ± 85 B.P., which fits within the timeline postulated for the Firebag Hills complex (Ives 1986:203; Reeves et al 2017:192).

Reeves et al. (2017:201) have assigned the Bezya site (HhOv-73), radiocarbon dated to 3990 ± 190 B.P., to the Firebag Hills complex. At this site, Le Blanc and Ives (1986) excavated a series of microblades and wedge-shaped microblade cores from what appeared to be a disturbed hearth. Five microcores and 103 microblades were recovered from this site, as well as a notched burin and burin spalls. The investigators were able to reconstruct the technology used in the microblade production of the site through refit studies (Le Blanc and Ives 1986). Contrary to Reeves et al.'s identification of the site as a Pre-Dorset occupation, Le Blanc and Ives (1986:88-89) suggest the assemblage most resembles the NWMt artifacts found in the Pointed Mountain

Complex of Fisherman Lake (Millar 1981; Section 4.2.2.5). Clark and Gotthardt (1999:173) note that while the Bezya site contains elements of the Denali tradition, such as Donnelly burins, the microcores are “not quite right” when compared with ones from the Campus type-site; however this could be a reflection of the fact that the Bezya site signifies a far southeastern diffusion of the technology in later times.

When Le Blanc and Ives first excavated the Bezya site, microblade technology was thought to be rare in the study region. However, a few years later Pyszczyk (1991) discovered a wedge-shaped microblade core near Fort Vermilion, at the Gull Lake (IcQa-11) site. Since that time a number of microblades and microcores have been discovered and are documented in the grey literature of archaeological consulting reports, but also in a small but increasing number of published articles (e.g.: Reeves et al. 2017:166, Stevenson 1986; Younie et al 2010:71). Ives (1993:10) proposes that the Gull Lake microcore best resembles the cores recovered from the Pointed Mountain complex (Millar 1981), and Younie et al. (2010) argue for a NWMt identification of the microblade cores recovered from the Little Pond (HiOv-89) site. It should also not be discounted that some of the microblade technology seen in Alberta could have origins from central and northern regions of British Columbia, where a number of microblade technologies have been identified (Clark and Gotthardt 1999; Fladmark 1985; Reeves et al. 2017; Sanger 1968; Smith 1974; Section 4.2.4).

4.3.4 The Late Period (2,500 to 300 B.P.)

The appearance of the Taltheilei Tradition (Section 4.2.2.4) marks the beginning of the Late period in northeastern Alberta. Sites with Taltheilei point types are common in both the lower Athabasca and Birch Mountains region (Reeves et al. 2017). One stemmed projectile point (Figure 4.4a), and one incomplete stemmed projectile point (Figure 4.4b), both collected from the Eaglenest Portage site, have been described as comparing favourably with specimens attributed to the Windy Point complex (Noble 1971; Section 4.2.2.4) of the Taltheilei Shale tradition (Donahue 1976:94; Ives 1977:27).

Figure 4.4 A) Stemmed projectile point surface collected from the Eaglenest Portage site. B) Incomplete stemmed projectile point recovered during excavations from the Eaglenest Portage site.

A number of side- and corner-notched projectile points recovered in northeastern Alberta also resemble Late Taltheilei specimens (Section 4.2.2.4). For example, fairly large side- to corner-notched projectile points found in the Birch Mountains are similar to Late Taltheilei points described by Gordon (Ives 2017: 14; Gordon 1996). However, many of the side- and corner-notched projectile points identified from the Late period could also be easily confused with points from the Middle period. Therefore, Ives (2017:293) recommends we confine our approach to only those artifacts that have been found in a reliable stratigraphic setting. Two projectile points recovered from a buried soil at the Eaglenest Portage site are associated with a radiocarbon date of 1030 ± 110 BP (Figure 4.5). This is a reasonable date for side- and corner-notched points from the Late Taltheilei tradition (Gordon 1996; Section 2.4.4.2). Ives (2017:306) also points out that these points bear a resemblance to Cayley series points of the Old Women's phase (Section 4.2.1.5). Furthermore, specimens from the Charlie Lake Cave site that resemble these points date to 1400 ± 400 years B.P. (Driver et al. 1996).

Figure 4.5 Two projectile points recovered from a buried soil at the Eaglenest Portage site. Charcoal from this layer yielded a radiocarbon date of 1030 ± 110 B.P.

More evidence for the Late Precontact period in northern Alberta comes from the Peace Point site, where Stevenson (1985, 1986) recovered a single small notched-projectile point. Associated dateable material recovered with this point radiocarbon dated to 1014 ± 75 B.P. Unfortunately, this was the only projectile point recovered from the site. However, if further excavations take place at Peace Point we may be able to gain further insights into the archaeological record of northern Alberta as it existed over the last 2,500 years. Stevenson (1986:55) also recovered artifacts that display characteristics of microblade and microcore technology. Clark (2001:70) proposes that those who occupied the site were on the verge of reinventing microblade technology, but "did not have it quite right." There is also the possibility that the bipolar splitting of Peace Point Chert nodules contributed to the incidental creation of microblade core-like instances rather than a purposeful techno-complex (Ives personal communication 2019). Other sites in the region have yielded materials known to be from the Late period such as the Pelican Beach site on the northern shore of Eaglenest Lake (Ives 1981), and the Wentzel Lake site in the Caribou Mountains (Conaty 1977). Unfortunately, neither site yielded many diagnostics.

The latter portion of the Late period in northern Alberta diverges slightly from what was taking place in the adjacent northern Saskatchewan region. In Saskatchewan, Laurel and Selkirk populations, characterized by ceramic artifacts (Section 4.2.3.3), mark the Late Period. In northern Alberta, ceramics are comparatively rare, only showing up at a handful of sites. Meyer and Russell (1987) have argued that the Selkirk population was ancestral to Cree or Algonquian speakers who moved into the area from the east. Ives (1993) believes that the earlier parts of the Late Period saw an expansion of Athabaskan speakers moving south and east into northern Alberta. This coincides with the introduction of Taltheilei cultures into northern Alberta, generally believed to be ancestral to modern day Dene. However, Meyer (2013) has identified Narrows Fabric-impressed ware at nine sites in northern Alberta. This could indicate a presence of the Buffalo Lake phase (Section 4.2.3.3) in northern Alberta; consequently, it is possible that they interacted with Taltheilei groups.

4.4 Conclusion

While the establishment of a cultural historical sequence for northern Alberta can be greatly enhanced by comparisons to adjacent regions, a lack of stratified sites and radiocarbon dates has hindered the formation of a tightly defined culture history; instead, only a tentative sequence has been developed. A more comprehensive culture history of the region can only be established by discovering and excavating well-stratified sites, such as the Peace Point site (Stevenson 1985, 1986), or through using spatial analytical techniques and refit studies, along with securely associated radiocarbon dates, to identify spatially and temporally related clusters of artifacts.

CHAPTER 5: THEORY AND METHODS

5.1 Introduction

The aim of this study is to determine if the interpretive problems presented by the rarity of stratified sites in the boreal forest (Chapter 1, Section 1.2) can be alleviated using three-point provenience measurements (north, east, and depth below datum) of artifacts found in situ and spatial analysis. According to Green (1990:3), "the spatial dimension is central to archaeology because it involves all levels of archaeological research - theory, method and practice." This chapter will discuss some of the theoretical considerations regarding spatial analytical studies of archaeological assemblages and will outline the methodology that was used to conduct an intrasite analysis of the assemblage from the Eaglenest Portage site.

5.2 Spatial Analysis in Archaeology

Spatial relationships have always been an important concept in archaeology. In fact, by the eighteenth-century archaeologists were generating maps of monuments and excavations (Wheatley and Gillings 2002:3). Generally, archaeologists tend to be concerned with two scales of spatial analysis: intrasite analysis, the examination of the spatial distribution of material culture (artifacts, ecofacts, and features) within a designated site; and intersite analysis, the examination of material culture between designated sites. For this study, the focus is placed on intrasite spatial analysis. Traditionally, the goal of intrasite spatial analysis has been the identification of activity areas through the distribution and patterning of particular artifact types (Simek 1984:405). Occasionally, it has also been used to identify temporally related clusters of artifacts at sites with multiple occupations, especially in contexts where occupations are hard to differentiate due to issues like compressed or disturbed stratigraphy (Ives 1985; McCulloch 2015; Rawluk et al. 2011). Archaeologists have used a range of techniques to examine the intrasite spatial patterns of artifact assemblages. These approaches have focused on methods which include the visual inspection of distribution maps (Whallon 1973:266), quantitative analysis of artifact distributions (Carr 1984; Falzarano 2014; Ives 1985; McCulloch 2015) and studies that investigate the distribution patterns of refitted materials (Cahen et al. 1979; Le Blanc and Ives 1986; Sisk and Shea 2008).

Methods and equipment selected during the initial planning phase of excavation, determine the quality and resolution of the data collected. All too often, the quality of the data is inadequate for a detailed intrasite spatial analysis of a site (Wheatley and Gillings 2002:209).

Currently, archaeological excavations in Alberta's boreal forest tend to be conducted by those working in the cultural resource management industry (Chapter 1, Section 1.2). Excavation methods usually involve shovel-shaving units in 50-by-50 cm quadrants with a vertical provenience that is limited to 10-cm arbitrary levels. Three-point provenience measurements are occasionally recorded for tools and cores, when they are observed in situ. But the vast majority of artifacts are recovered in the screen. At this scale of data recording it is difficult to perform a detailed intrasite spatial analysis for the artifact assemblage. However, archaeologists have developed many methods with which to meticulously record artifacts in three dimensions; although these methods may place greater demands on time and budget, their use makes intrasite spatial analysis much more feasible.

5.2.1 Computerized Spatial Analysis

In the last few decades, archaeological research has been enhanced by a variety of computerized techniques. Geographic information system (GIS) software has become a useful tool for handling, storing, analyzing, and processing spatially referenced information (Ebert 2004; Kvamme 1999). Although the history of GIS goes back to 1963 (Tomlinson 1963), archaeological analysis using GIS is still a relatively new advancement. It was not until the 1990s, with the increased processing power of computers, that GIS became popular among archaeologists (Kvamme 1999:154; Leiff 2006:10). Initial studies utilizing GIS were heavily weighted towards intersite spatial analysis, focusing primarily on landscape-scale studies that focused on building models for predicting site locations (Kvamme 1990, 1992; Wheatley 1995; Wheatley and Gillings 2002).

The trend of using GIS mainly for intersite spatial analysis continued into the 2000s. However, in recent years, GIS studies with an intrasite focus have become more commonplace in archaeology (D'andrea et al 2002; Falzarano 2014; Kasstan 2004; McCulloch 2015; Mills 2007; Moyes 2002). GIS is an important tool for intrasite studies, because it allows archaeologists to create digital maps with which to manage large quantities of geospatial data to solve spatial problems (Ebert 2004).

Archaeological excavations are conducted in a three-dimensional space and are broken into measurable excavation units of standard sizes, often of 1-by-1-m; this allows identified features and artifacts to be accurately recorded in terms of their three-dimensional placement. Still, archaeologists typically conceive of excavation units as comprised of a series of "discrete, horizontal, stratigraphic levels" (Moyes 2002: 9). Excavation units therefore are frequently mapped in as multiple levels using two-dimensional plan views. Interpretation and analysis of data of this nature can prove difficult, especially in environments where stratigraphic relationships are uncertain and cultural levels cannot be easily defined. One of the features of GIS software is the ability to map artifact distributions in three dimensions. This allows a researcher to generate a three-dimensional map of an artifact assemblage, which can be rotated and viewed in all angles. While computer-aided three-dimensional analysis of archaeological sites is still in its infancy, recent studies have emerged in which such research has been effectively employed (Kasstan 2004; Falzarano 2014; D'andrea et al. 2002; Moyes 2002).

5.2.2 Site Formation Processes

The spatial distribution of artifacts at an archaeological site is determined by both cultural and natural processes (Schiffer 1976, 1983, 1987). Cultural processes relate to human activities that influence the depositional pattern of archaeological materials. Post-depositional and natural processes may alter the depositional pattern of an artifact assemblage and make it difficult to determine which artifacts are culturally related. Further complicating the matter is the fact that many archaeological sites in the boreal forest were revisited, sometimes on a seasonal basis or irregularly over longer periods. The problem of compressed or limited stratigraphy means that sites with multiple occupations become compacted into a shallow site with no sterile soil horizons between them (Reid 1988:191). Intrasite spatial analysis studies play an important role in understanding the extent to which cultural and natural processes modified where the artifacts were originally discarded, and in determining which artifacts may be temporally related. A firm grasp on site formation processes is a crucial step to the analysis of any archaeological site.

A number of natural processes affect the distribution of artifacts at archaeological sites. This includes, but is not limited to, cryoturbation, faunalturbation, and floralturbation (Schiffer 1987; Wood and Johnson 1978). Cryoturbation is a process which causes disturbance to sediments by freeze/thaw action within seasonally frozen ground and permafrost. These actions can displace artifacts vertically and in some cases orient artifacts on a vertical axis (Schiffer 1987). Floralturbation refers to the disturbance of sediment through plant activity, including root growth and tree throws. As trees become uprooted shallow depressions are created in the ground surface as sediment and artifacts are carried within the root plate of the tree. This process can alter both the vertical and horizontal placement of artifacts. Faunalturbation is the mixing of sediment by animals. In the boreal forest, this type of mixing is often caused by burrowing rodents such as ground squirrels, mice, voles, or shrews. Larger animals such as bears can also be a source of faunalturbation and even some small burrows created by ants, earthworms, spiders, or frogs can significantly alter the distribution of artifact remains at an archaeological site. Small artifacts tend to be displaced upwards due to tunnelling or burrowing activity, although downward movement may occur when collapsed tunnels infill with sediment (Schiffer 1987). Large objects, on the other hand, are often too heavy to have been moved upwards by small burrowing animals and as a result may accumulate at the lower deposits of an archaeological site (Morin 2006). Other natural processes which can affect the formation of an artifact assemblage in the study region include forest fires, and wind or water erosion.

Cultural formation processes refer to the movement of artifacts due to human activities. This can include the stages of use of a lithic material from its procurement, to its shaping and use as a stone tool, to its disposal, and occasionally its re-formation for later use if it is recycled. Human activities can intentionally and unintentionally disperse artifacts of different size categories both horizontally across living spaces and vertically within deposits (Stevenson 1991:270-271). Unintentional size sorting occurs in an archaeological assemblage through the trampling of small artifacts which become embedded in occupation surfaces by foot traffic. Larger artifacts are often intentionally horizontally displaced towards the periphery of activity areas where foot traffic is reduced.

Human activities situated around a fire can also alter where artifacts are left behind. In studies of contemporary peoples, it has been observed that in activity areas centered on a hearth, smaller artifacts tend to fall in the vicinity of the individual, in what has been termed a drop zone (Binford 1978; Stevenson 1991). Meanwhile larger artifacts are picked up and tossed backwards from the hearth into what Binford (1978) termed the toss zone. These kinds of cultural processes can significantly alter the distribution pattern of artifact assemblages, and this must be considered when analyzing archaeological sites.

5.2.3 Intrasite Studies in Northern Alberta

The first and one of the few intrasite spatial analysis studies of an archaeological site in northern Alberta was Ives' analysis of the Eaglenest Portage materials (Ives 1977, 1985; Chapter 3, Section 3.2.1.1). Ives focused solely on the horizontal distribution of finished artifacts and the vertical component was not considered (Ives 1985). This was due to the perceived vertical mixing of artifacts from post-depositional processes (Section 5.2.1). Using various quantitative methods, Ives was able to isolate clusters of artifacts that were hypothesized to be temporally related (Ives 1985; Chapter 3, Section 3.2.1.1). Though Ives (1985) was able to determine various horizonal clusters within the data, his research focused on two-dimensional space, and he only analyzed the distribution of finished artifacts; addition of a third dimension, depth, and the ability to analyze the entire assemblage, provides even greater understanding to spatial distributions, particularly in sites with limited stratigraphy.

At the Strathcona Science Park site (FjPi-29), for instance, Pyszczyk's (1981) use of a three-dimensional model allowed him to document that projectile point styles tended to be vertically arranged in their correct chronological order, even though the site had no definable stratigraphy. Inspired by the work of Pyszczyk, Rawluk et al. (2011) presented a method which relied upon diligent attention to the three-point provenience of artifacts to construct a digital based three-dimensional model of the lithic assemblage at Ahai Mneh (FiPp-33), another site with poor stratigraphic definition. The subsequent analysis, based on the distribution of different raw material types, allowed for the designation of three empirically segregated components. The earliest of these correlates with an Agate Basin/Hell Gap complex occupation which could not be clearly separated from the overlying Besant, Oxbow, and McKean complex occupations during the excavation and initial analysis of the site. These studies suggested that a more thorough spatial analysis of the three-point provenience data from the Eaglenest Portage site, employing more recently developed computer programs, may provide invaluable information regarding the spatial distribution of artifacts in a boreal forest environment.

5.3 Methodology

Questions raised at the outset of this research influenced the type of data that were needed in order to conduct a detailed intrasite analysis of an archaeological site in Alberta's boreal forest. In this region, many sites consist of a seemingly random accumulation of artifacts created through repeated occupations. In these circumstances it can become difficult to distinguish which artifacts are temporally related to one another. The methods outlined in this chapter offer one solution to alleviate the difficulties of excavating a multi-component site in an area with limited stratigraphy, where natural and cultural processes may have moved artifacts from where they were initially deposited.

5.3.1 Site Selection Process

Finding a northern Alberta site suitable for intrasite spatial analysis was a challenging process. Many sites have been discovered and excavated in advance of development projects. However, only a handful of sites have been excavated in a manner suitable for this research. Ultimately, site selection was contingent on three main factors:

1. The site must have been excavated in such a way that three-point provenience measurements (X, Y, and Z coordinates) were recorded for every artifact found in situ.
2. The site must be comprised of multiple occupations, spanning multiple time periods.
3. The site assemblage is made up of a variety of lithic raw materials and artifact types.

The inclusion of a variety of lithic materials and artifact types aids in the identification of discrete clusters which may be temporally related. For example, when knapping a stone tool, one can expect a clustering of a specific raw material at one area of the site. The same can be said of specific activities that may occur at a site. For instance, if hide working occurred, the expectation may be to find a cluster of tools and artifacts such as exhausted scrapers or chi-thos that are consistent with the hide working process.

A few of the sites located in the Birch Mountains met the first set of criteria; however, a majority of those sites are small, and it was not possible to determine if they contain multiple occupations. After careful consideration, it was decided that the site which best matched the above criteria was the Eaglenest Portage site. The excavation procedures followed at the site ensured that the coordinates for each artifact in the assemblage was recorded in three dimensions (Ives 1985:31-32). The discovery of a large artifact assemblage spread across multiple blocks, consisting of both pre-contact and historic materials, support the idea that the site contained multiple occupations (Ives 1985:106). Additionally, the site contains many raw material and artifact types, making it an ideal site for this analysis.

5.3.2 Fieldwork

One of the difficulties of research in northern Alberta is that archaeological sites are often located in remote areas, and access can be not only challenging, but expensive. The Eaglenest Portage site is located deep in the boreal forest and can only be accessed via helicopter or float plane. Initially, this study was to have included additional work at the Eaglenest Portage site to collect supplementary data. These new data could then be compared to the original data that was obtained by Ives. A total of 10 to 20 m^2 of new excavations was proposed; however, budget constraints meant that only a limited amount of time could be spent in the field. In September 2014, a total of 33 shovel tests and a test excavation of 1.5 m^2 were excavated to develop firsthand familiarity with Ives' observations of the site structure.

The fieldwork began with relocating the original excavation blocks. A topographic site map (Chapter 3, Section 3.2.1.1, Figure 3.1) was used to find the approximate location of the blocks. Shovel tests, measuring approximately 40 x 40 cm, were opened in order to confirm the location of the blocks and to find an appropriate location in which to open up a new test excavation. A small test excavation was placed next to the shovel test which contained the most diverse range of lithic raw material types.

Excavation began with the establishment of a north/south baseline which was used to triangulate an east/west line. Trowels were used for excavation and northing, easting, and depth below datum measurements were recorded to the nearest centimetre for all artifacts recovered in situ. All measurements were made from the southwest corner of each unit using string and line level and the surface depth of each corner was recorded relative to a fixed datum, which was established just north of the test excavation. All sediment was screened using a 6.0-by-2.9-mm diamond-shaped mesh screen.

Although the fieldwork component of this research collected too small a sample for it to allow direct comparison to data from the original 1970s excavation, it did provide an opportunity in which to contextualize those original data. Firsthand observations were made which provide insight into the types of natural processes that could have affected artifact distributions (Figure 5.1). These included rodent burrows, tree throws, root growth, erosion, and even possible trampling from animals along game trails. A buried Ae soil horizon was also noted in the excavation block and in some of the shovel tests (see Chapter 2, Section 2.5, Figure 2.5 and 2.6).

Figure 5.1 Example of faunalturbation at the Eaglenest Portage Site in the form of a squirrel's nest.

5.3.3 Lithic Analysis

Artifacts excavated during the 1975 field season were washed and catalogued under the supervision of Ives (see Chapter 3, Section 3.2.1.1). Unfortunately, the digital catalogue which was constructed in the 1970s was unavailable; however, a computer print-out was provided by Ives, which contained each artifact's provenience information, raw material type, and artifact type. This information was entered into Excel spreadsheets, along with the weight and size class of each artifact. Weight for each artifact was collected to the tenth of a gram, and each artifact was placed into one of four size categories based on its longest dimension. These size categories were micro debitage (0 to 0.66 cm), small debitage (0.66 to 2.5 cm), medium debitage (2.5 to 5.0 cm) and large debitage (greater than 5.0 cm). No attempt was made to reclassify the artifacts identified by Ives; however, a few of the artifacts were assigned new raw material classifications.

5.3.3.1 Lithic Analysis: Refitting

Refit studies can provide general information regarding the sequence of flake removals from cores, and also provide important data on the spatial distribution of artifacts (Kasstan 2004:48). Ives attempted to refit some split pebbles and core fragments during his initial analysis of the assemblage; however, he found it to be highly time consuming (Ives 1985:ii). Therefore, for the purposes of the current study an effort was made to find additional artifacts within the assemblage that refit together. Both the horizontal and vertical spatial components of artifacts that were found to refit were analyzed as these patterns can provide information about post-depositional movement or disturbance. Although the Eaglenest Portage materials would benefit from an in-depth refit analysis, due to time constraints this was limited only to refits that were discovered during the re-examination of the artifacts in addition to the refits discovered by Ives.

5.3.3.2 Lithic Analysis: Debitage and Tools

A variety of artifact types were recovered from the Eaglenest Portage site, including historical artifacts and bone; however, the clear majority of the artifacts consist of lithic debitage and tools. Ives (1985:35) identified six categories of lithic debitage at the site including core rejuvenation flakes, decortification flakes, retouch/resharpening flakes, bifacial reduction flakes, fragments, and shatter. Tools identified from the site were scrapers, projectile points, bifaces, unifaces, cobble/spall tools (chi-thos), wedges, hammerstones, and expedient tools such as retouched and utilized flakes. Additionally, many cores and split pebbles were recovered at the site. No attempt was made to reclassify the artifacts identified by Ives. Careful attention was placed on analyzing the spatial distribution of the different artifact types that were identified within the Eaglenest Portage assemblage.

5.3.3.3 Lithic Analysis: Raw Materials

Previous studies have shown that analyzing the distribution pattern of lithic raw materials at multicomponent sites can aid in empirically segregating components (Rawluk et al. 2011). Therefore, diligent attention was paid to analyzing the distribution of raw materials at the Eaglenest Portage site. In total, Ives (1985) and Donahue (1976) identified a total of 10 different lithic raw material types from the Eaglenest Portage site, including quartzite, Beaver River Sandstone (BRS), quartz, black chert, other chert, argillite, salt-and-pepper quartzite, sandstone, coarse-grained quartzite, and Tertiary Hills Clinker (THC) (Chapter 3, Section 3.2.1.1). Subsequent analysis of the materials for this study determined that other raw materials also exist within the assemblage including a red siltstone, a black silicified quartzite, and Peace Point Chert (Figure 5.2). During the reanalysis of the artifacts, it was also decided that artifacts that were originally placed in the “other chert” category should be further subdivided based on colour (e.g., green chert, red chert, etc.).

Figure 5.2 Materials that were reclassified in the Eaglenest Portage assemblage; Peace Point Chert, black silicified quartzite, and red siltstone.

5.3.4 GIS: Visual Analysis

The first step in identifying spatial patterns within the Eaglenest Portage assemblage was to convert the Excel spreadsheets into shapefiles using Esri's ArcGIS 10.2. This program was chosen for this study due to its widespread use in archaeology and its ability to run spatial analytical tests. The two main types of data used in GIS are areal data and point data (Ebert 2004). Point data are usually discrete occurrences (with XY/XYZ coordinates) that tend to represent individual objects such as artifacts or features. Areal data, on the other hand, are a series of continuous data such as topography or vegetation (Ebert 2004:321). At the site level, areal data lacks three-point provenience and therefore can only be described in bulk groups, such as artifacts that were collected through the screening of excavated sediment. This study focused only on point data that was collected with three-point provenience measurements since screens were not used during the initial excavation of the Eaglenest Portage site.

Shapefiles containing three-point provenience data for each artifact were imported into ArcScene 10.2. This allowed for the creation of a three-dimensional map that can be rotated and viewed in all angles (Figure 5.3). In this capacity, GIS became a useful tool in which to visually assess the assemblage for spatial patterning. Maps were created for all four blocks excavated by Ives. After the data were entered into the program, they could be arranged into various GIS layers and themes based on size class, raw material and artifact type, and this ultimately aided in the interpretation process.

The visual inspection of the data allowed for the preliminary detection of possible patterns within the overall assemblage; however, it does have its drawbacks. The biggest drawback is the human tendency to perceive meaningful patterns within random data. Another drawback of visually assessing the data is that some of the observed patterns can be influenced by the way artifacts are symbolized, such as the size of the symbols used. Clusters could also exist within the data, but be missed, due to point values overlapping with each other. Therefore, to properly assess the data, a series of spatial statistics were employed in order to ensure that the patterns that were being observed were statistically valid.

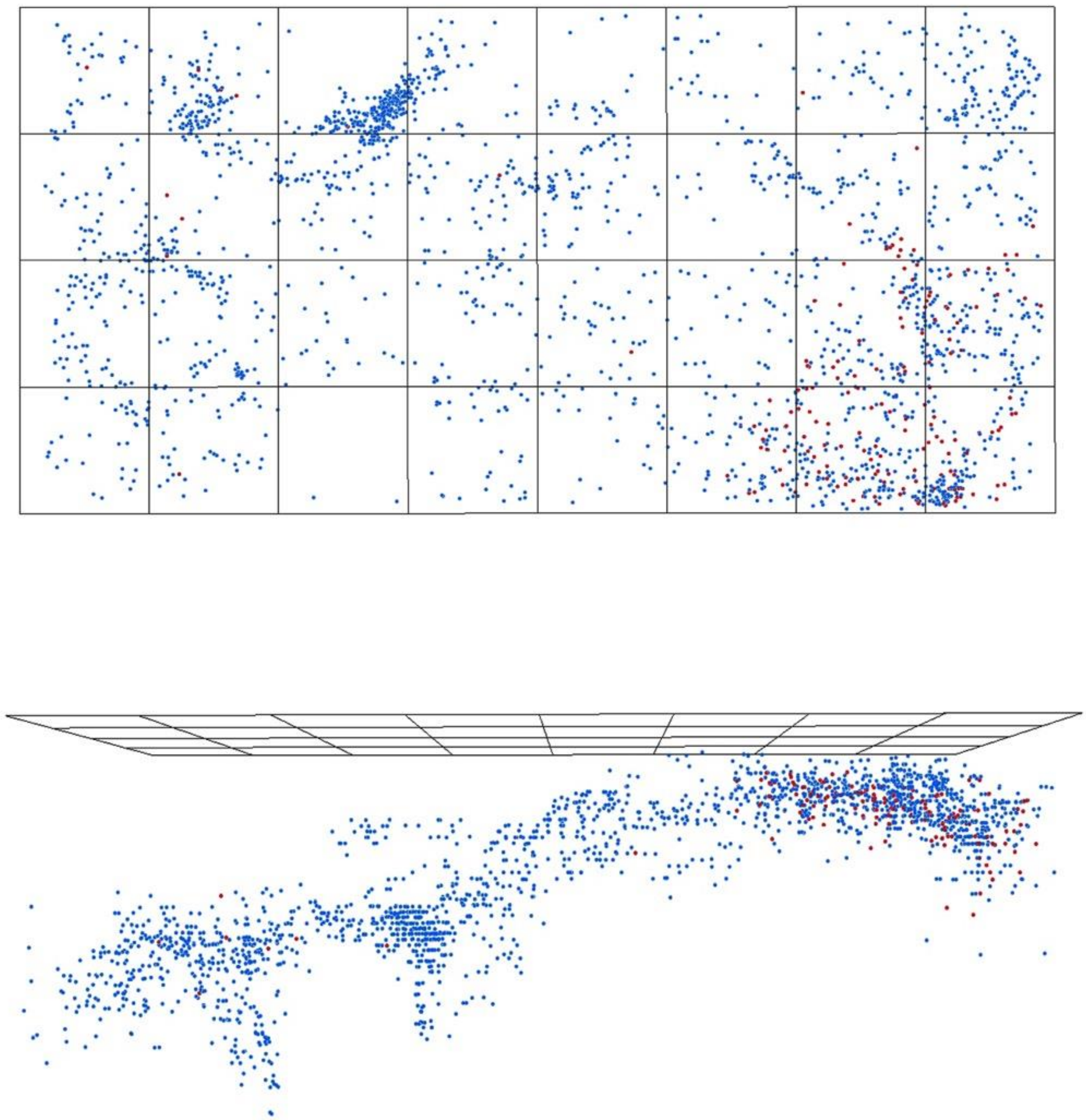


Figure 5.3 Example of a three-dimensional map of Block C created in ArcScene 10.2.

5.3.5 Spatial Statistics

Initial visual inspection of the Eaglenest Portage data demonstrated potential patterns or clusters; however, spatial statistics offered an opportunity to more accurately interpret the assemblage. The selection of appropriate statistical methods must take into consideration both the advantages and disadvantages of the techniques employed, as well as their suitability for the data being analyzed (Anderson and Burke 2008:2275). It is also important to use a variety of statistical measurements to ensure that the clusters observed in ArcGIS are statistically valid (McCulloch 2015; Mills 2007). Therefore, this research employed a variety of methods in order to gain a more accurate characterization of artifact clustering in the Eaglenest Portage assemblage.

An important aspect of spatial statistics is the null hypothesis. For the techniques being employed in this study the null hypothesis is that the artifacts are randomly distributed. The alternative hypothesis is that the artifacts are either clustered or evenly dispersed (Figure 5.4). A variety of statistical techniques were employed to determine if distribution of artifacts recovered from the Eaglenest Portage site were the result of random chance, or if they were statistically clustered. Methods employed were surface interpolation, nearest neighbour (NN) analysis, kernel density estimation (KDE), hot spot analysis, and k-means. Surface interpolation allowed for the identification of patterns or trends that occurred vertically, while NN analysis, KDE, hot spot analysis and k-means were used to identify horizontal clusters of artifacts within the Eaglenest Portage data. The spatial distribution of artifacts was analyzed by raw material, artifact type, and size class.

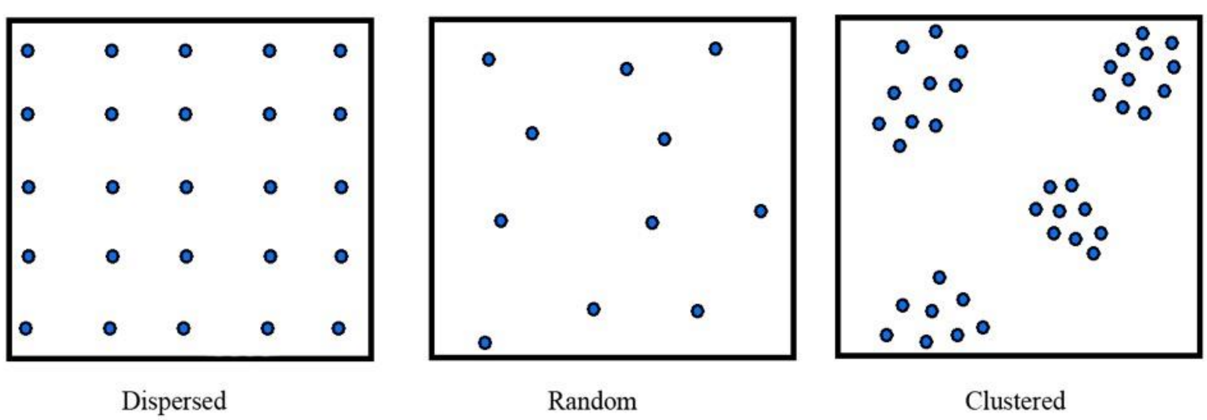


Figure 5.4 Types of spatial distributions: The data can either be evenly dispersed, randomly distributed, or clustered.

5.3.5.1 Surface Interpolation

To examine any vertical trends that may be present in the Eaglenest Portage assemblage, this study relied on the raster interpolation tool that is built into the 3D Analyst toolbox of ArcScene 10.2. Interpolation methods use a number of mathematical procedures in order to convert point distributions into a continuous surface (Ebert 2004:322). Interpolation is commonly used to create maps of modern landscape features from discontinuous data; however, there has been an increasing interest in applying these methods in order to recreate prehistoric landscapes (Connolly and Lake 2004; Falzarano 2014).

A number of methods have been derived to interpolate surfaces from point values. For this study, an Inverse Distance Weighting (IDW) method of interpolation was used. IDW is considered a local method of interpolation. Local interpolators make predictions based on the distance of points from each other and attempt to model variability as accurately as possible (Conolly and Lake 2006). The mathematical formula to calculate IDW is as follows (Falzarano 2014:179; Krivoruchko 2011:253):

Equation 1 Inverse Distance Weighting.

$$\hat{Z}(s_0) = \sum_{i=1}^{n} \lambda_i Z(s_i) \qquad \lambda_i = \frac{d_{i0}^{-p}}{\sum_{i=1}^{n} d_{i0}^{-p}}$$

where $\hat{Z}(s_0)$ is the predicted value at an unsampled location s_0, $Z(s_i)$is the known value in the location s_i (in this case the depth value of the artifacts), λ_i is the weight of the sample point, and d_{i0} is the distance between locations s_0 and s_i.

For this research, the interpolation of depth measurement of groups of artifacts were used to create a continuous surface based on the distribution of artifacts by type, material and size class. This made it possible to evaluate vertical trends and relationships between groups of cultural materials. One of the advantages of an interpolated surface is the ability to discern trends that would otherwise be difficult to identify through individual point values (Falzarano 2014:94). The comparison of interpolated surfaces of different artifact groups allowed for a better observation of trends in their depth values. Once interpolated surfaces were created for each class of artifact, these surfaces were visually assessed to see if any trends in vertical distribution patterns could be observed. If the artifact depths were similar, then the interpolated surface of different artifacts should overlap. Likewise, if the artifact depths were significantly different, then this should be apparent when comparing the interpolated surfaces.

5.3.5.2 Nearest Neighbour (NN) Analysis

The NN statistical technique (Clark and Evans 1954; Whallon 1974) has been employed by several studies to examine the spatial distribution of artifacts at archaeological sites (Ives 1985; McCulloch 2015; Mills 2007). Ives (1985) used NN analysis in his original examination of the Eaglenest Portage materials; however, he was only concerned with the distribution patterns of finished artifacts (Chapter 3, Section 3.2.1.1). For this study, a NN analysis was performed for each artifact type, raw material type, and size class that was recovered from the site to determine if the artifacts displayed signs of being horizontally clustered.

ArcGIS allows a researcher to perform a NN test from within the program. The NN statistic determines the average distance of a point from its nearest neighbour and compares this information with what would be expected from a randomly distributed pattern. The equation used by ArcGIS to determine the NN is (Esri 2016a):

Equation 2 Nearest Neighbour Analysis.

$$NN = \frac{\overline{D}_o}{\overline{D}_E}$$

where $\overline{D}_o$ is the observed mean distance between each artifact and its nearest neighbour and $\overline{D}_E$ is the expected mean distance for artifacts in a random pattern. The NN output in ArcGIS provides a graph with an associated z-score that determines the likelihood that the pattern could be the result of random chance.

While the NN technique has been employed in a number of archaeological studies, there have been several objections to its use (Connelly and Lake 2006:164; Hodder and Orton 1976; Kintigh 1990; Pinder et al. 1979). The most prominent of these objections has to do with what has been termed the "boundary effect"; the idea that the size of the study area may determine whether or not a pattern is deemed significantly clustered. For instance, in Block A, a total of 16 m^2 were excavated by Ives (1985). When analyzed at the scale of the block (16 m^2), NN analysis determines that salt and pepper quartzite has a z-score of 0.769972, indicating a random distribution of this material type. However, when removing square meters around the edge of the block that do not contain salt and pepper quartzite, NN analysis produces a z-score of -4.69471549669 indicating that salt and pepper quartzite is evenly dispersed. For the purpose of this study, each NN test was done at the scale of each block. This information was used as a preliminary step in order to determine if the clusters that were visually observed are statistically valid, or to see if clusters may occur in situations where visual analysis did not detect them.

A second issue with NN, is the fact that this method only takes into account the first neighbour, no matter which direction it lies in; so, if clustering is evident, it is recognized at a very small scale (Clark and Evans 1954:450; Connolly and Lake 2006:164; Hodder and Orton

1976:41). Therefore, NN was used only as an initial step which in tandem with other statistical methods helped to determine if statistically significant patterning exists in the Eaglenest Portage assemblage.

5.3.5.3 Kernel Density Estimation (KDE)

KDE is a method that has been used for a variety of archaeological studies (Baxter et al. 1997; Mills 2007; McCulloch 2015; Reid 2014). This method can be performed from within ArcGIS to generate a smoothed density contour map which can be used to identify horizontally based clusters and potential outliers in both point and line data (Esri 2016b). To calculate the kernel density of point data, ArcGIS uses a method first formulated by Silverman (1986:15). The most important parameter affecting the KDE is the search radius, the distance from a reference point that is used to calculate the density (Mills 2007:11-12; Reid 2014:125).

Choosing too large or too small a search radius can severely distort the results. If the radius is too high, clusters can be merged together (Figure 5.5), and if too small the resulting density map will be too localized to produce any meaningful results. Mills (2007:12) and Reid (2014:125) both suggest experimenting with the value in order to find a search radius that produces the best result. Another option is to allow ArcGIS to calculate the best search radius for you. ArcGIS will calculate the search radius using the following formula:

Equation 3 Search Radius for Kernel Density Estimation.

$$SearchRadius = 0.9 * min\left(SD, \sqrt{\frac{1}{\ln(2)}} * D_m\right) * n^{-0.2}$$

where SD is the standard distance, D_m is the median distance and n is the number of points in the data set (Esri 2016b).

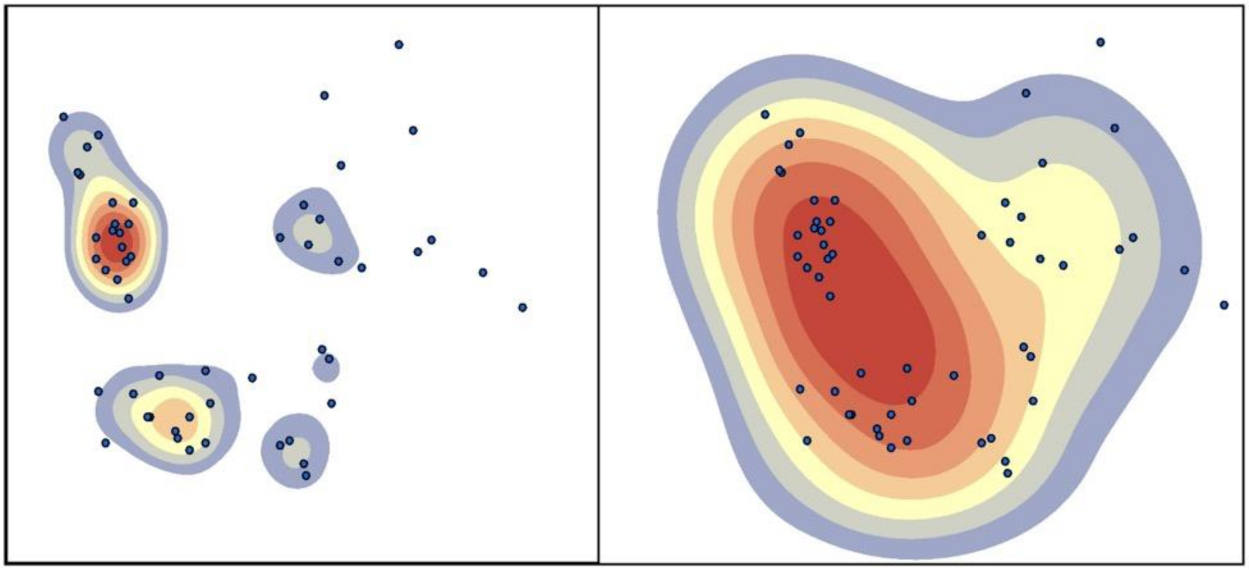


Figure 5.5 Example of two KDE maps produced in ArcGIS. The map on the left uses a search radius of 30 cm whereas the map on the right uses a search radius of 90 cm.

To analyze the Eaglenest Portage assemblage, KDE maps were created for each artifact class that showed clustering according to NN analysis. The default settings in ArcGIS were used to calculate the search radius for each of the density maps that were produced. Using the default settings prevented potential bias that may occur by experimenting with the values until the desired result was obtained. Artifacts that fell within the identified hotspots were then isolated from any outliers and combined into a single shapefile.

5.3.5.4 K-Means

Artifacts that clustered according to NN analysis and that were associated with the hotspots according to KDE, were then broken into horizontal clusters using K-means. K-means is perhaps one of the most common statistical methods used for the intrasite analysis of archaeological sites (De Bie et al. 2002; Enloe et al. 1994; Gregg et al. 1991; Johnson and Johnson 1975; Falzarano 2014; Kintigh 1990; McCulloch 2015; Moyes 2004). When performing the k-means algorithm, each point is placed into a specified number of clusters in a way that attempts to minimize the sum-squared error (SSE) (Kintigh 1990:185). The SSE is simply the sum of the squared distances from each point to the center of the cluster to which it was defined. To determine cluster membership random point locations, equal to the number of clusters defined by the researcher, are placed within the study area as seed points (McCulloch 2015:97). Each point is then assigned membership to the cluster that it is closest to. New seed points are created from within this centre, and the points are then reassigned. This process continues until the distance between points and their center cannot be reduced any further (Connolly and Lake 2006:171).

Many issues can arise with the k-means algorithm. For instance, the researcher must define the number of clusters (k) in the data set. This can be challenging when the number of clusters is unknown. However, one suggestion is to run the algorithm on the dataset for a range of values of k (For example $k2$ through $k10$) and then to plot the SSE for each cluster number on a line graph (McCulloch 2015; De Bie et al 2002). If the line graph looks like an arm, then the "elbow" on the arm determines which cluster number is best suited for the data (Figure 5.6). However, one of the drawbacks of this method is that the "elbow" cannot always be unambiguously identified, especially if the line graph is smooth with no defined "elbows" (Ketchen and Shook 1996).

A second issue with the k-means algorithm is that it will assign cluster memberships even when the data are uniform. Therefore, even if the dataset has no clusters within it, k-means will assign clusters regardless. Furthermore, each point in a dataset will be assigned a cluster membership even if it is an outlier. This is especially problematic in an archaeological context where post-depositional processes may have significantly altered where artifacts were deposited. Horizontal and vertical mixing of artifacts likely took place at the Eaglenest Portage site, and therefore it was important to be as cautious as possible regarding cluster memberships.

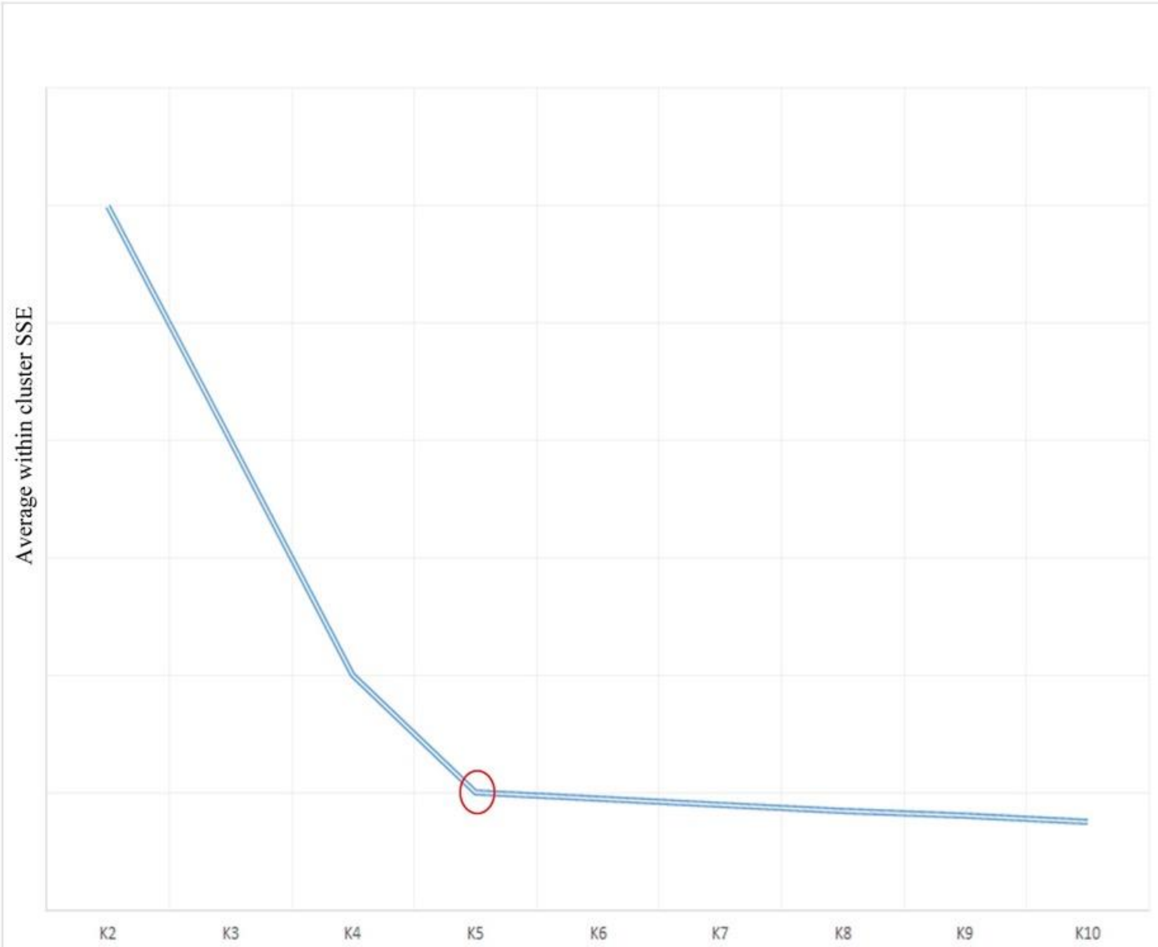


Figure 5.6 Example of the "elbow" method for determining cluster numbers in a dataset. In this example the optimal clustering solution would be k=5.

A third issue with the k-means algorithm is that when faced with uneven sized clusters, it will sometimes give more "weight" to the larger clusters in an effort to reduce the sum of squares (Robinson 2015). In this scenario, k-means allows the smaller cluster to end up far away from any of its seed points in an effort to split up the much larger cluster. This means that even if the dataset has clearly defined clusters, k-means may assign data points that should belong to the smaller cluster to the larger cluster (Figure 5.7).

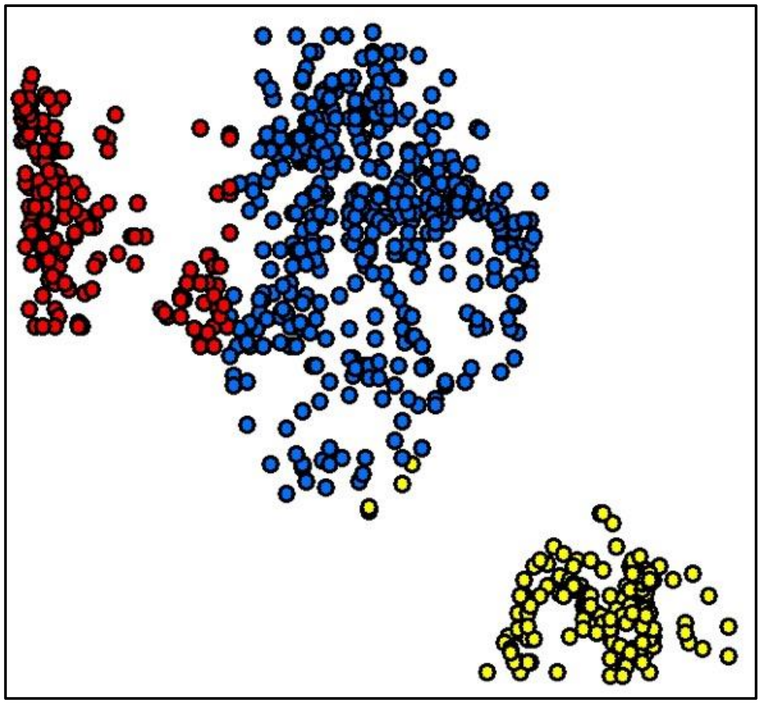


Figure 5.7 Example of one of the issues of the k-means algorithm when faced with uneven sized clusters. In this example k-means was run with three clusters. Data points from the smaller clusters were included in the larger cluster in an effort to reduce the sum of squares.

Given the issues with k-means, and the likelihood that post-depositional processes moved artifacts around at the Eaglenest Portage site, this algorithm was applied very cautiously to the data. K-means can be used to determine clusters in three dimensions; however, surface interpolation determined that while vertical patterning is present among some artifact classes, the vast majority of artifacts were vertically mixed. Therefore, the k-means algorithm was only used to give cluster membership to artifacts that displayed clustering horizontally. Artifacts which showed clustering according to NN analysis and that also fell within the KDE hotspots were grouped into clusters using the k-means algorithm. The elbow method was used to determine the number of clusters present in each block. This technique was applied by using the Statistical Package for the Social Sciences program and visualized using ArcGIS.

5.3.5.5 Hot Spot Analysis

Hot spot analysis is a relatively new quantitative method of statistical analysis which has only been used in a small number of archaeological studies (Keach 2014; Mills 2007). It is more commonly used for studies such as mapping crime frequencies in particular neighborhoods (Eck et al. 2005; Scott and Warmerdam 2005). However, the methods employed by hot spot analysis make it a potential tool for intrasite spatial analysis of an archaeological site. In ArcGIS, hot spot analysis can be conducted by using the optimized hot spot analysis tool. This tool uses the Getis-Ord Gi* statistic (Getis and Ord 1992; Ord and Getis 1995) to calculate hot or cold spots within a series of data. A hot spot is simply a statistically significant cluster that contains high values of artifacts and a cold spot is a statistically significant area within the data set that contains a low value of artifacts. To calculate hot and cold spots, the program first creates a fishnet, or a grid of polygon squares, and aggregates the points that fall within each square (Figure 5.8). The program then runs the Getis-ord Gi* statistic (Esri 2016c):

Equation 4 Getis Ord GI*.

$$G_I^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \bar{x} \sum_{j=1}^{n} w_{i,j}}{s \sqrt{\frac{\left[n \sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j} \right)^2 \right]}{n-1}}}$$

where x_j is the attribute value of feature j and $w_{i,j}$ is the spatial weight between feature i and j, and n is equal to the total number of features. In order to calculate $\bar{x}$ and s the following equations are used (Esri 2016c):

Equation 5 Getis Ord GI*.

$$\bar{x} = \frac{\sum_{j=1}^{n} x_j}{n} \qquad s = \sqrt[n]{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{x})^2}$$

By calculating these formulas, the program can determine the statistically significant hot and cold spots within a data set to 90, 95, and 99 percent confidence.

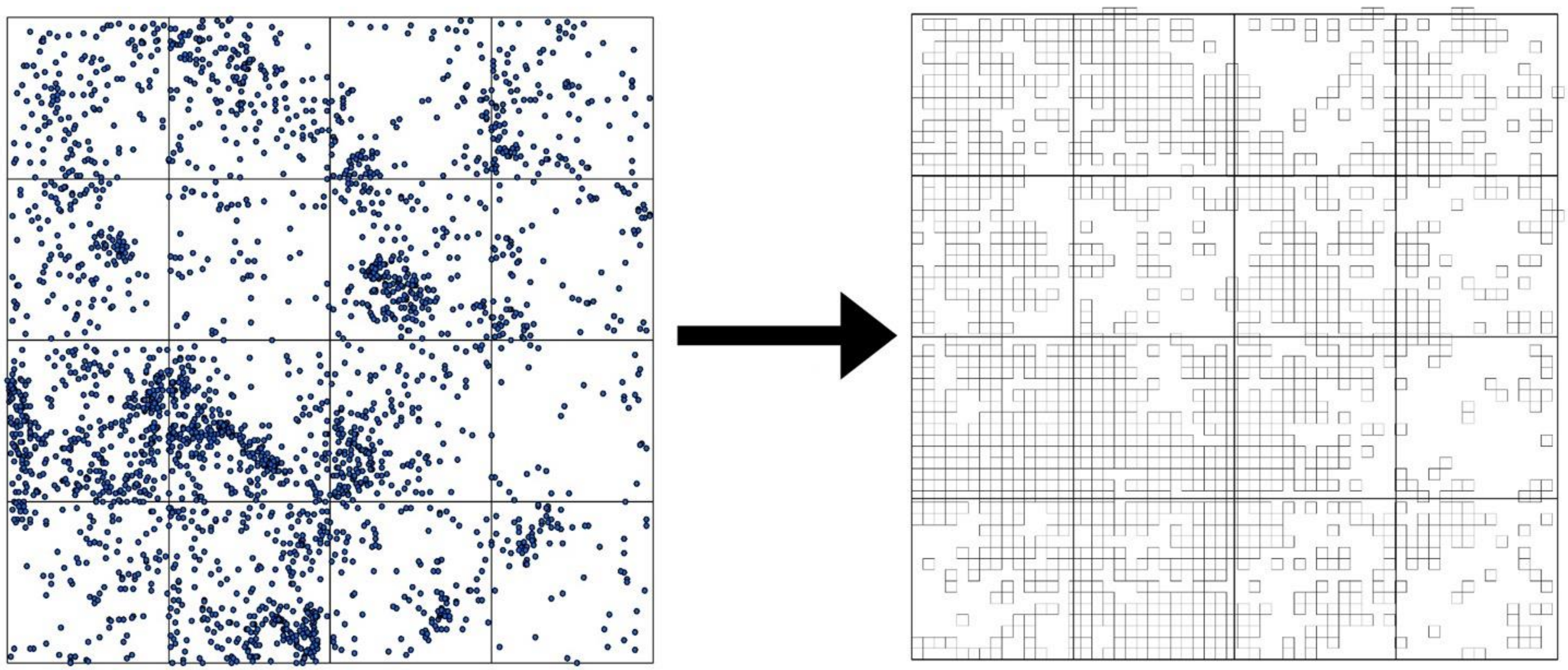


Figure 5.8 When running the optimized hot spot analysis tool in ArcGIS point values are first converted into a fishnet, or a grid of polygon squares, and the point values of each polygon are aggregated together.

Unlike NN analysis, which only takes into account the first nearest neighbour, for an artifact to be considered part of a hotspot it must be surrounded by other artifacts that are also considered to be in statistically significant hotspots. This means that there may be polygons in the dataset that have a high number of artifacts but are considered to be statistically insignificant. It is also important to note that to run the optimized hot spot analysis tool, there need to be at least 30 features in the data set. A hotspot analysis test was conducted for all the artifacts contained in the Eaglenest Portage assemblage. The clusters determined by hotspot analysis were then compared to the results from the clusters determined by NN analysis, KDE, and k-means. This provided an additional statistical method with which to determine if horizontal clusters exist in the data that were missed using the previous methods.

5.3.6 Cluster Interpretation

Once clusters were defined using the above-mentioned methods, clusters were then visually examined to determine what kinds of artifacts were in each cluster. This examination took into consideration lithic raw material type, artifact type, and size class in order to interpret the horizontal and vertical patterns that were observed in the Eaglenest Portage materials. Additionally, refits were mapped, to determine if they matched up with the defined clusters. Refits within clusters strengthen the interpretation of clusters as being temporally related; whereas refits between clusters may represent secondary deposition or post-depositional disturbance. The clusters from each block were also compared to the clusters determined by Ives (1985).

5.3.6.1 Identification of Invisible Hearth Features

Attention was paid to the distribution of heat-altered and organic materials contained within and around each cluster. The presence of heated materials can occur naturally in an archaeological assemblage, especially in a forested environment where wildfires are likely to occur. However, human activities around a fire can also be a source of heated materials. Hearth features are typically identified through analysis of burned sediment, typically based on the exposure of areas of discolored soils. However, the typical discoloration of sediment seen in hearth features can sometimes disappear due to weathering and leaching (Alperson-Afil et al. 2007:1). Therefore, the discoloration of sediments is not always a reliable method in which to identify hearths. Unfortunately, hearth features in the study region are often not identified due to soil conditions and other agents of disturbance that act to obscure evidence of heated sediments.

At the Barger Gulch site, in Middleton Colorado, Waguespack and Surovell (2014:38) were able to identify an "invisible hearth" feature based on the distribution of burned materials. The feature did not exhibit the sedimentary characteristics typical of a hearth that can be recognized during excavation but was instead identified through the spatial distribution of burned materials. Waguespack and Surovell (2014) based their interpretation on an experimental study done by Sergant et al. (2006), in which lithic materials were thrown into a camp fire and then excavated. The study determined that dense clusters of overheated artifacts "should be interpreted as the remains of former surface hearths" (Sergant et al. 2006). Waguespack and Surovell (2014:39) further hypothesized that areas of the site that contained a low density of artifacts, but a high percentage of which are heated, may be indicative of areas in which cleaning and dumping of hearth contents occurred.

Another study, conducted by Alperson-Afil and colleagues (2007), set out to determine if the dispersion of burned materials at the Gesher Benot Ya'aqov site in Israel was due to anthropogenic or natural forces. Alperson-Afil et al. (2007:2) hypothesized that the distribution of burned materials caused by human activity should contain a variety of burned materials that display clustering rather than a random or uniform distribution. They also suggested that a cluster of burned materials representing a hearth feature would be made up of small artifacts, as these are more likely to be left in situ (Alperson-Afil et al. 2007:11). This suggestion is consistent with Binford's (1978) observations of drop zones around a hearth where small artifacts are left behind (Section 5.2.2). The hearths identified through spatial analysis at the Gesher Benot Ya'aqov site were termed "phantom hearths" due to the fact that they contained no directly observable features during excavation (Alperson-Afil et al. 2007).

Clusters that contained a dense amount of heat-altered material at the Eaglenest Portage site were analyzed to determine if they could be classified as invisible or phantom hearths. It has been demonstrated that hearths tend to be centers of human activity where food processing, food consumption, tool processing, and hide work are often conducted (Binford 1978; Yellen 1977). Therefore, any potential hearth features identified at the Eaglenest Portage site would contain a diverse set of artifacts displaying the range of activities that occur near hearth features.

5.4 Conclusion

ArcGIS and spatial analysis have greatly enhanced the ability of archaeologists to conduct detailed intrasite studies of archaeological sites. After potential patterns were observed in the Eaglenest Portage data through a detailed visual assessment of three-dimensional maps, application of a series of spatial analytical methods allowed for the identification of spatial clusters. NN analysis, KDE, hot spot analysis and k-means allowed for the designation of horizontal clusters. Interpolation methods helped determine if any patterns were present in the vertical distribution of artifacts.

CHAPTER 6: RESULTS

6.1 Introduction

This chapter presents the results of the spatial analysis of the Eaglenest Portage site, following the methods outlined in Chapter 5. Each of the four blocks excavated by Ives (1985) will be discussed separately, along with the output of the visual and statistical tests.

6.2 Block A

Block A is situated directly adjacent to the edge of a terrace that overlooks the drainage between Eaglenest and Clear Lakes (Chapter 3, Figure 3.2). This block is considered an area of high artifact density with a total of 2,609 artifacts recovered from an area measuring 16 m^2 (Ives 1985:45). Artifacts recovered from Block A include lithic materials (n=2573), historic artifacts (n=25), and faunal remains (n=11). Table 6.1 gives a break down of each artifact recovered from Block A according to raw material, artifact type, and size class. Block A contained the most diverse number of lithic raw materials and artifact types recovered from the site. Ives (1985:164) established the presence of two horizontal artifact clusters within the block. The dense number of artifacts recovered and the presence of both stemmed and side-notched projectile points interpreted as representing different periods led Ives to strongly suspect that cluster overlap may have occurred within Block A (Ives 1985:106).

Table 6.1: Artifacts recovered from Block A grouped by lithic raw material, artifact type, and size class (note raw material total is without historic artifacts or faunal remains).

Artifact Grouping		Count
Raw Material	Argillite	38
	Beaver River Sandstone (BRS)	60
	Black Chert	51
	Green Chert	19
	Grey Chert	114
	Peace Point Chert	39
	Red Chert	5
	White Chert	6
	Sandstone	34
	Red Siltstone	14
	Quartz	103
	Quartzite	1700
	Salt and Pepper (S&P) Quartzite	13
	Heat-altered Quartzite	303
	Heat-altered S&P Quartzite	6
	Black Silicified Quartzite	36

	Coarse Grained Quartzite	32
	Total	**2573**
Artifact Type	Flake Fragment	1418
	Block Shatter	513
	Resharpening Flake	235
	Decortification Flake	240
	Bifacial Reduction Flake	80
	Core Rejuvenation Flake	1
	Edge Modified (Utilized)	28
	Edge Modified (Retouched)	19
	Split Pebble	6
	Core	3
	Projectile Point	4
	Endscraper	10
	Uniface	1
	Spall/Cobble Tool	9
	Faunal Remains	11
	Hammerstone	1
	Wedge	1
	Side Scraper	4
	Historic	25
	Total	**2609**
Size Class	Micro Debitage (0 to 0.66 cm)	63
	Small Debitage (0.66 to 2.5 cm)	2166
	Medium Debitage (2.5 to 5 cm)	232
	Large Debitage (over 5 cm)	30
	Unclassified	119
	Total	**2609**

6.2.1 Visual Assessment of Block A

Visual assessment of Block A considered both the horizontal and vertical placement of artifacts based on type, material, and size class. A visual analysis of the horizontal distribution of artifacts determined that when grouped by raw material, multiple patterns emerged. However, when grouped by artifact type, only a few patterns were noticed. While many artifacts, such as those made of quartz, appeared to cluster into tightly compact groupings, other artifacts, such as those made of quartzite, were densely distributed throughout the block, making it difficult to observe any interpretively or culturally significant patterns (Figure 6.1). Table 6.2 outlines which artifacts appeared to be distributed into tightly compact clusters and which were distributed in such a manner that no significant patterns were noted.

Vertical trends were difficult to assess due to the dense number of artifacts in the assemblage. However, there is a clear difference in the depth values of a cluster of artifacts observed in the north end of the block. A close examination of this cluster reveals that this was entirely restricted to two excavation units (Figure 6.2). Because this discrepancy was only observed within these two units, and not seen elsewhere in the block, it is assumed that this issue was likely caused by human error in the original catalogue. Therefore, due to the uncertainty of the legitimate depth values of the artifacts and to avoid any potential errors, these units were excluded in the vertical assessment. Other than this, no vertical patterning of artifacts was noted.

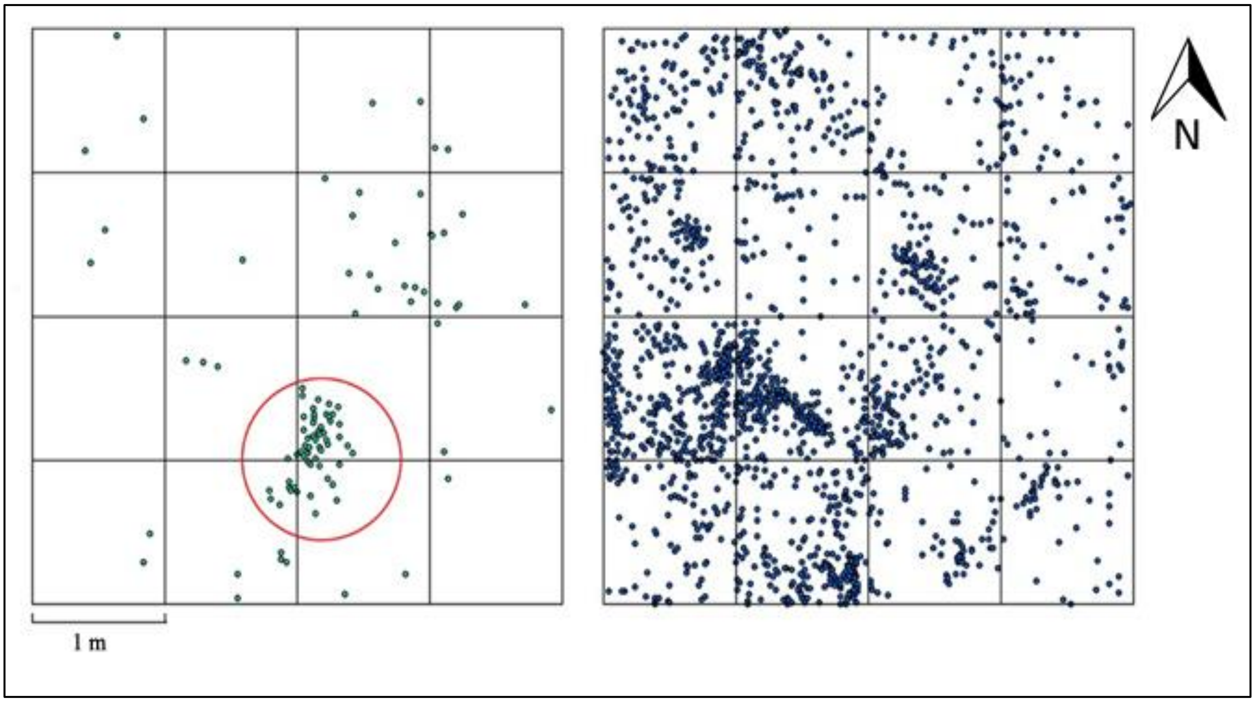


Figure 6.1 Example of patterns observed through visual analysis. Quartz artifacts were densely clustered and quartzite artifacts were too densely distributed for any interpretive value.

Table 6.2 Artifacts from Block A that appeared to be clustered based on a visual analysis of the artifacts by raw material, type, and size class.

Artifact Grouping	Patterns Observed	No Patterns Observed
Raw Material	Argillite	Coarse Grained Quartzite
	Black Chert	Salt and Pepper Quartzite
	Black Silicified Quartzite	Sandstone
	Beaver River Sandstone	Quartzite
	Green Chert	Heat-altered Salt and Pepper Quartzite
	Grey Chert	Heat-altered Quartzite
	Red Chert	White Chert

	Red Siltstone	
	Peace Point Chert	
	Quartz	
Artifact Type	Endscraper	Flake Fragment
	Faunal Remains	Block Shatter
	Edge Modified (Utilized)	Resharpening Flake
		Decortification Flake
		Bifacial Reduction Flake
		Core Rejuvenation Flake
		Edge Modified (Retouched)
		Split Pebble
		Core
		Projectile Point
		Uniface
		Spall/Cobble Tool
		Hammerstone
		Wedge
		Side Scraper
		Historic
Size Class	Micro debitage (0 to 0.66 cm)	Small debitage (0.66 to 2.5 cm)
	Large debitage (over 5 cm)	Medium debitage (2.5 to 5 cm)

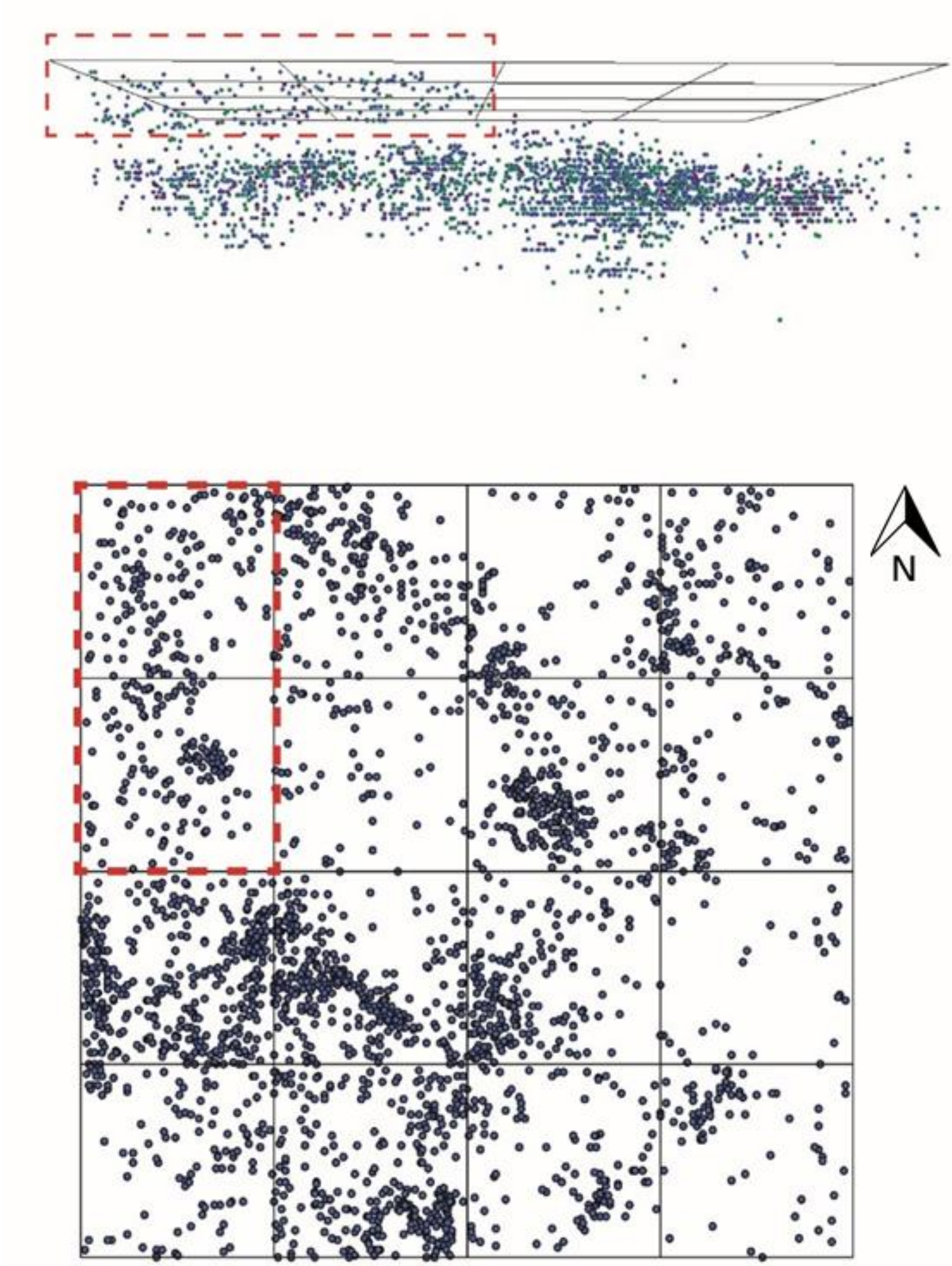


Figure 6.2 Artifacts from the highlighted units were significantly shallow compared to the rest of the artifacts recovered from Block A.

6.2.2 Statistical Analysis of Block A

An initial visual inspection of the Block A data determined that many artifacts appeared to cluster horizontally based on raw material type. However, no vertical patterning of artifacts was noted. To ensure that the observed patterns are valid, and to ensure that no spatial clusters were missed, quantitative analysis was employed.

6.2.2.1 Block A: Surface Interpolation

A surface interpolation test (see Chapter 5, Section 5.3.5.1) was conducted for each artifact grouping from Block A containing more than one artifact. A surface interpolation test was not conducted for core rejuvenation flakes, unifaces, hammerstones, or wedges because each of these categories only contained one artifact, precluding any potential patterning.

The test determined that most artifacts recovered from Block A were randomly distributed vertically, with little to no statistical patterning. However, there were a few exceptions. BRS artifacts were only recovered between 15 to 30 centimetres below datum (cmbd). Additionally, 81 percent of the microdebitage was recovered below 15 cmbd. In contrast, historic artifacts, faunal remains, and green chert were only recorded between 5 to 19 cmbd.

All other artifacts from Block A were randomly distributed anywhere between 5 to 59 cmbd. A clear example in the differences in the depth values between artifacts can be observed when comparing the interpolated surfaces. For instance, there is a clear difference in the interpolated surface generated between historic materials and BRS (Figure 6.3). Table 6.3 shows which artifacts from Block A showed distinct vertical distribution patterns and which ones did not.

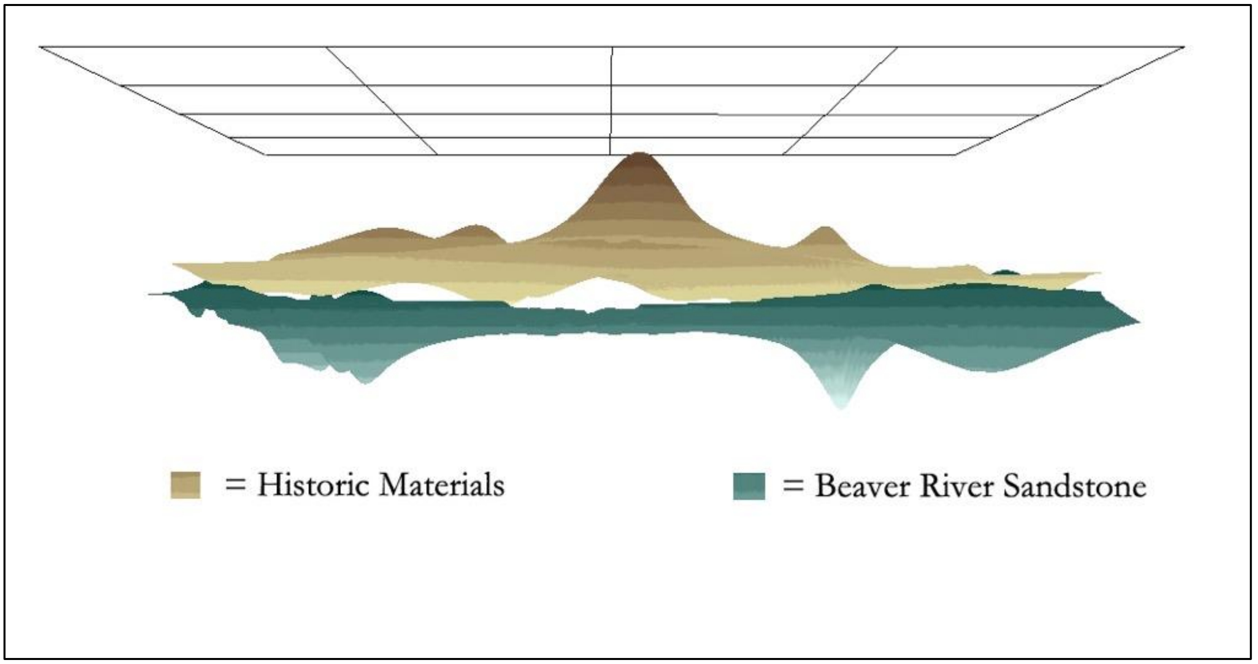


Figure 6.3 Example of the interpolated surface of two artifact groups showing a clear difference in the distribution of artifacts based on depth.

Table 6.3 Artifacts which displayed vertical patterning according to the Surface Interpolation test.

Artifact Grouping	Vertical Patterns Observed	No Vertical Patterns Observed
Raw Material	Beaver River Sandstone	Argillite
	Green Chert	Black Chert
		Black Silicified Quartzite
		Coarse Grained Quartzite
		Grey Chert
		Peace Point Chert
		Red Chert
		Red Siltstone
		Salt and Pepper Quartzite
		Sandstone
		Quartzite
		Heat-altered Salt and Pepper Quartzite
		Heat-altered Quartzite
		Quartz
		White Chert
Artifact Type	Historic	Flake Fragment
	Faunal Remains	Block Shatter
		Resharpening Flake
		Decortification Flake

		Bifacial Reduction Flake
		Edge Modified (Utilized)
		Edge Modified (Retouched)
		Split Pebble
		Core
		Projectile Point
		Spall/Cobble Tool
		Side Scraper
Size Class	Micro debitage (0 to 0.66 cm)	Small debitage (0.66 to 2.5 cm)
		Medium debitage (2.5 to 5 cm)
		Large debitage (over 5 cm)

6.2.2.2 Block A: Nearest Neighbour Analysis

A nearest neighbour (NN) test (see Chapter 5, Section 5.4.5.2) was conducted for each artifact category in Block A containing more than one artifact. A NN test was not conducted for hammerstones, wedges, unifaces, or core rejuvenation flakes, because only one artifact fell into each of these categories, and therefore no nearest neighbour could be calculated.

The NN test confirmed that clusters exist within the data that were not apparent through visual analysis. For instance, a visual assessment of the distribution of decortification flakes revealed an apparently random distribution, whereas the NN test found their distribution to be statistically clustered (Figure 6.4). Furthermore, the results of the NN test determined that some artifacts which appeared to cluster based on a visual inspection were randomly distributed. For example, the NN test determined that the distribution of faunal items in Block A is statistically no different than random. However, a visual assessment of the distribution of faunal showed an apparent cluster within one excavation unit (Figure 6.5). Table 6.4 shows a list of which artifacts were determined to be statistically clustered or distributed randomly across the block according to the NN output.

The NN tests determined that when grouped by raw material, a clear majority of lithic artifacts are significantly clustered. Only 4 of the 17 different raw material types are distributed in a way that was documented as random. Of the 15 artifact types, 7 were established to be statistically clustered and 8 were randomly distributed. In terms of the distribution of artifacts by size class, artifacts of all size categories were determined to be distributed in clusters across the excavation block.

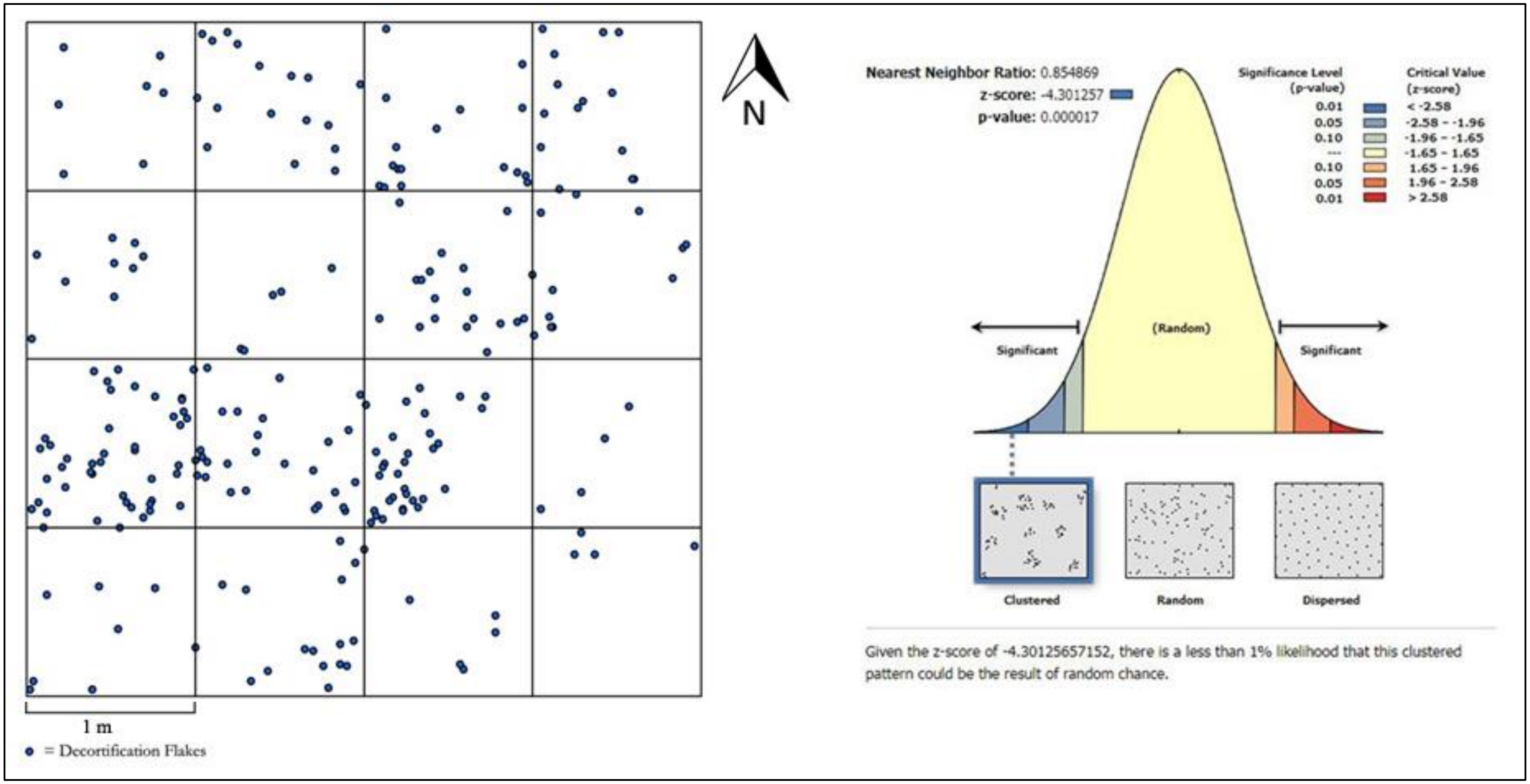


Figure 6.4 Distribution of decortification flakes (left) and the results of the nearest neighbour test for decortification flakes (right).

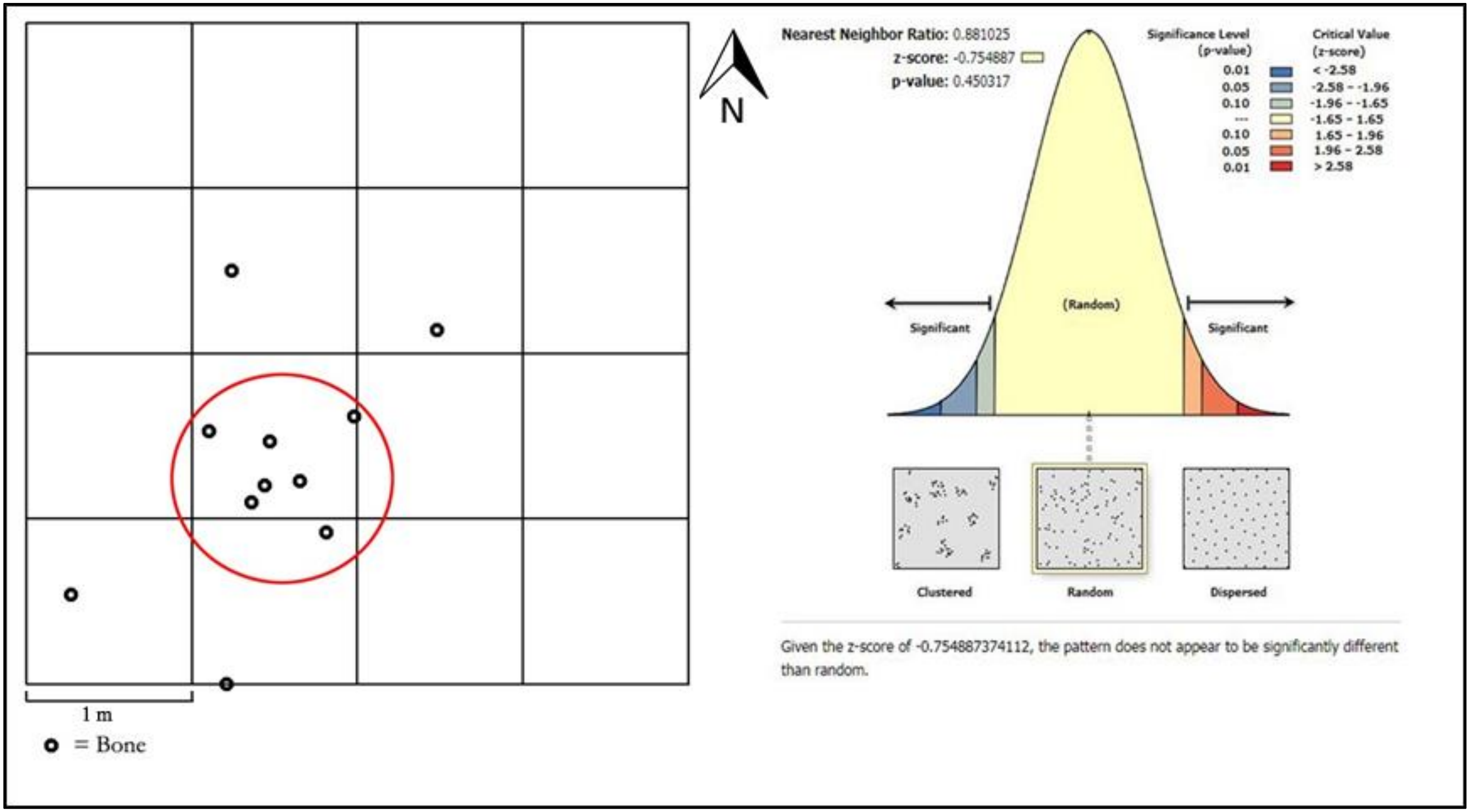


Figure 6.5 Distribution of faunal remains appearing clustered within one unit (red circle), the NN output for faunal remains (right).

Table 6.4 Results of the NN test for Block A based on each artifact raw material, artifact type, and size class.

Artifact Grouping	Clustered	Random
Raw Material	Argillite	Coarse Grained Quartzite
	Black Chert	White Chert
	Black Silicified Quartzite	Salt and Pepper Quartzite
	Beaver River Sandstone	Heat-altered Salt and Pepper Quartzite
	Grey Chert	
	Green Chert	
	Peace Point Chert	
	Quartz	
	Quartzite	
	Heat-altered Quartzite	
	Red Chert	
	Red Siltstone	
	Sandstone	
Artifact Type	Decortification Flake	Bifacial Reduction Flake
	Endscraper	Core
	Flake Fragment	Projectile Point
	Resharpening Flake	Edge Modified (Retouch)
	Block Shatter	Edge Modified (Utilized)
	Spall/Cobble Tool	Side Scraper
	Split Pebble	Historic
		Faunal Remains
Size Class	Micro debitage (0 to 0.66 cm)	
	Large Debitage (over 5 cm)	
	Medium Debitage (2.5 to 5 cm)	
	Small Debitage (0.66 to 2.5 cm)	

6.2.2.3 Block A: Kernel Density Estimation

The NN test confirmed that many artifacts recovered from Block A were statistically clustered. Kernel Density Estimation (KDE) maps (Chapter 5, Section 5.3.5.3) were generated for each group of clustered artifacts. Figure 6.6 shows an example of a KDE map generated for Block A decortification flakes. Artifacts that fell within the designated hotspots were isolated from the rest of the artifacts and combined into a single shape file. Of the 2,609 artifacts recovered from Block A, 884 were included in the clustered dataset. Table 6.5 displays all the artifacts that were included within the designated hotspots according to the KDE maps, and Figure 6.7 shows how they were distributed throughout the block.

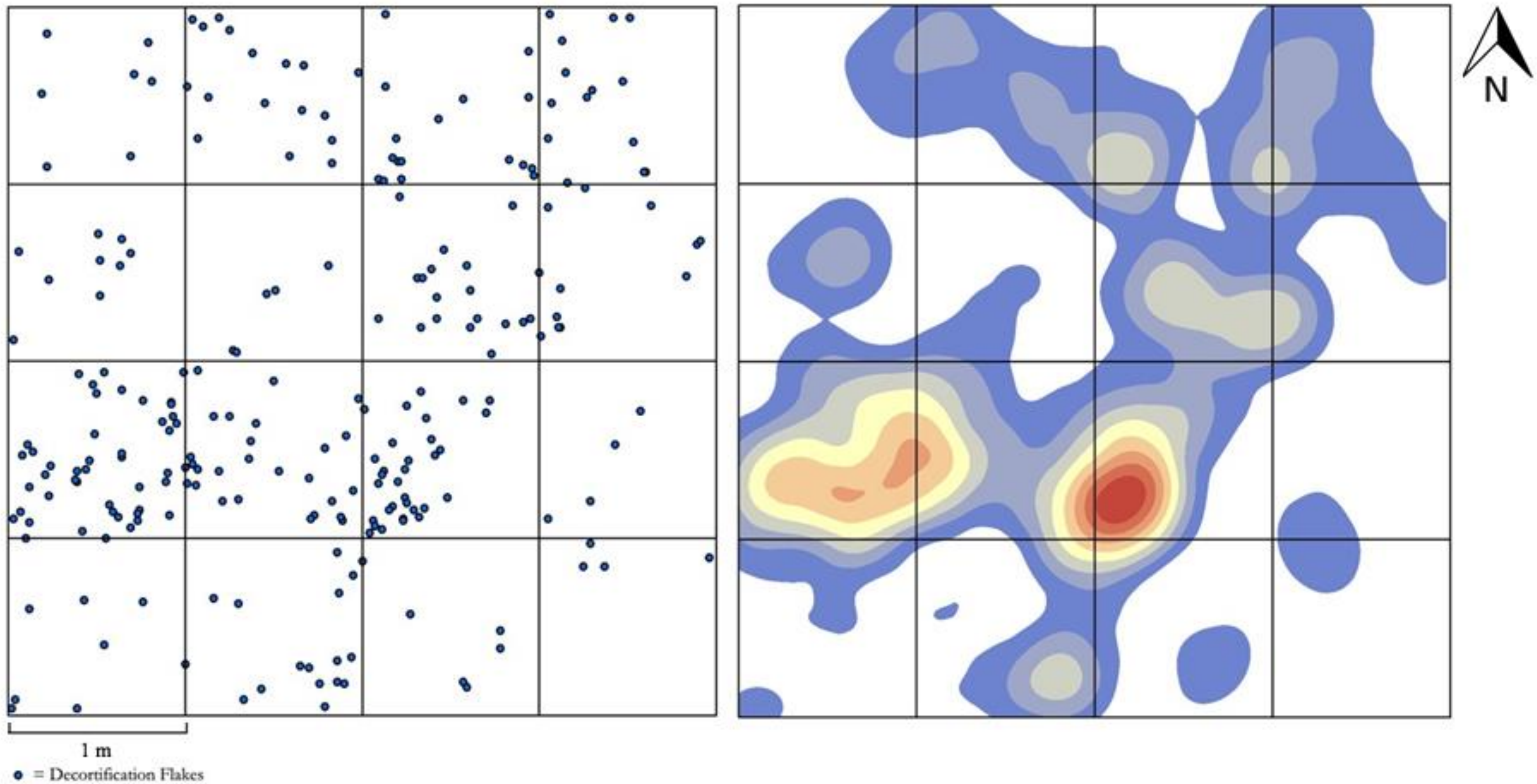


Figure 6.6 KDE map created for decortification flakes recovered from Block A.

Table 6.5 Artifacts from Block A that were included in the clustered dataset, grouped by raw material, artifact type, and size class.

Artifact Grouping	Type	Frequency
Raw Material	Argillite	13
	Black Chert	14
	Black Silicified Quartzite	15
	BRS	31
	Coarse Grained Quartzite	5
	Grey Chert	39
	Green Chert	16
	Peace Point Chert	16
	Quartz	49
	Quartzite	557
	Heat-altered Quartzite	94
	Red Chert	2
	Red Siltstone	8
	Salt and Pepper Quartzite	3
	Heat-altered S&P Quartzite	2
	Sandstone	20
	Total	**884**
Artifact Type	Bifacial Reduction Flakes	20
	Block Shatter	175
	Core	2
	Decortification Flake	94
	Edge Modified (Utilized)	6
	Edge Modified (Retouched)	3
	Endscrapers	7
	Flake Fragment	475
	Resharpening Flake	86
	Side Scraper	1
	Split Pebble	6
	Spall/Cobble Tool	8
	Uniface	1
	Total	**884**
Size Class	Micro Debitage (under 0.66 cm)	15
	Small Debitage (0.66 to 2.5 cm)	737
	Medium Debitage (2.5 to 5 cm)	82
	Large Debitage (over 5 cm)	15
	Unclassified	35
	Total	**884**

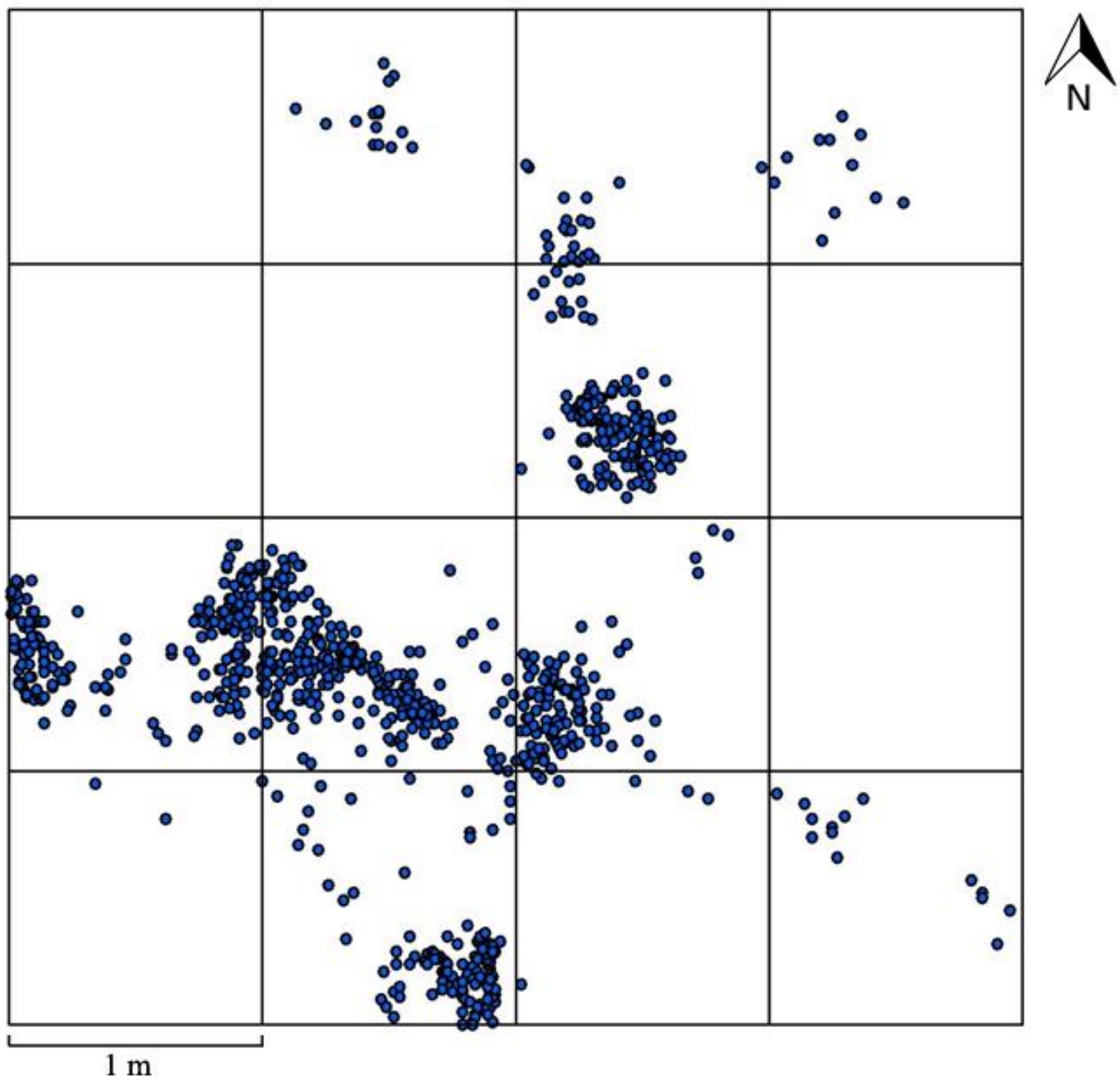


Figure 6.7 Distribution of artifacts from Block A that fell within the clustered dataset according to NN analysis and KDE maps.

6.2.2.4 Block A: K-Means

Once the clustered dataset was determined, the K-means algorithm was applied to the data in order to define cluster membership of each artifact. Using the elbow method (Chapter 5, Section 5.3.5.4) it was determined that nine clusters were contained within the dataset. Figure 6.9

shows how the artifacts were grouped according to cluster membership. Each cluster was labeled consecutively MRA1 through MRA9.

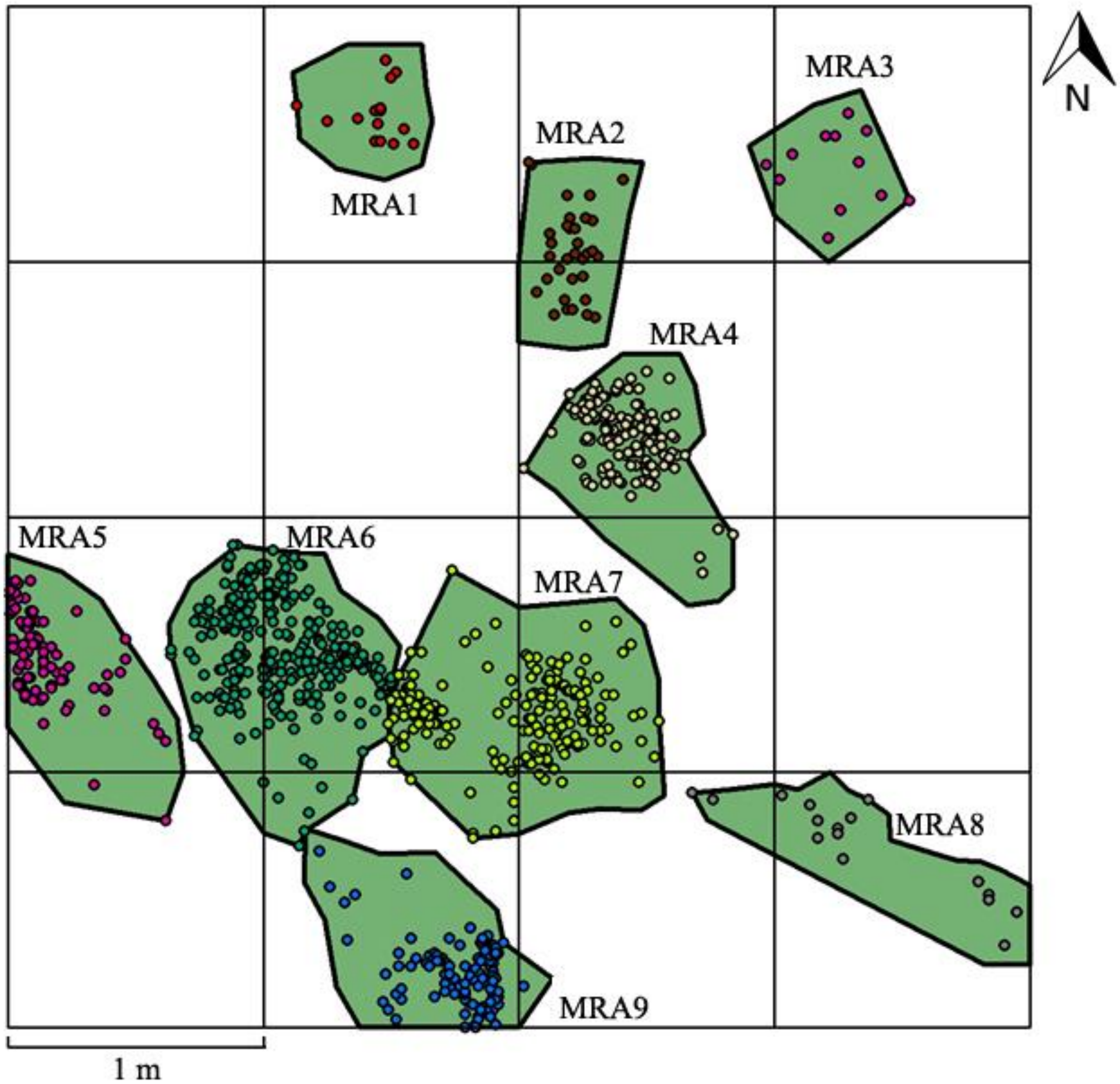


Figure 6.8 Distribution of clusters in Block A as determined through the K-means algorithm

Cluster MRA1 (Table 6.6) yielded a total of 15 lithic artifacts. All artifacts within this cluster are made from BRS. These include flake fragments (n=10), block shatter (n=2), bifacial reduction flakes (n=1), and re-sharpening flakes (n=2). The cluster consists mainly of micro debitage (n=10).

Table 6.6 Artifacts contained in Cluster MRA1

Artifact Grouping	Type	Frequency
Raw Material	Beaver River Sandstone	15
	Total	**15**
Artifact Type	Flake Fragment	10
	Block Shatter	2
	Bifacial Reduction Flakes	1
	Resharpening Flake	2
	Total	**15**
Size Class	Micro Debitage (0 to 0.66 cm)	10
	Unclassified	5
	Total	**15**

Cluster MRA2 (Table 6.7) consists of 33 artifacts made up of green (n=12) and grey (n=21) chert. There is one utilized flake fragment within the cluster and the debitage consists of flake fragments (n=16), block shatter (n=5), decortification flakes (n=5), and re-sharpening flakes (n=5). One split pebble was also contained within the cluster. Most of the artifacts consist of small debitage (n=30), with lesser amounts of micro (n=2) and medium debitage (n=1).

Table 6.7 Artifacts Contained in Cluster MRA2

Artifact Grouping	Type	Frequency
Raw Material	Green Chert	12
	Grey Chert	21
	Total	**33**
Artifact Type	Flake Fragment	16
	Block Shatter	5
	Decortification Flakes	5
	Edge Modified (Utilized)	1
	Split Pebble	1
	Resharpening Flake	5
	Total	**33**
Size Class	Micro Debitage (0 to 0.66 cm)	2
	Small Debitage (0.66 to 2.5 cm)	30
	Medium Debitage (2.5 to 5 cm)	1
	Total	**33**

Cluster MRA3 (Table 6.8) contains 12 lithic artifacts made from red chert (n=2), red siltstone (n=7), and sandstone (n=3). No tools were recorded within this cluster, which is made up mainly of flake fragments (n=9). The cluster also contains a single piece of block shatter, one decortification flake, and one re-sharpening flake. All the artifacts recovered from this cluster were small debitage.

Table 6.8 Artifacts contained in Cluster MRA3.

Artifact Grouping	Type	Frequency
Raw Material	Red Chert	2
	Red Siltstone	7
	Sandstone	3
	Total	**12**
Artifact Type	Flake Fragment	9
	Block Shatter	1
	Decortification Flakes	1
	Resharpening Flake	1
	Total	**12**
Size Class	Small Debitage (0.66 to 2.5 cm)	12
	Total	**12**

Cluster MRA4 (Table 6.9) contains a diversity of lithic raw material types including quartzite (n=63), black silicified quartzite (n=15), salt and pepper quartzite (n=2), black chert (n= 12), grey chert (n=18), green chert (n=4) sandstone (n=4), and quartz (n=3) artifacts. The debitage in the cluster consists of flake fragments (n=72), one bifacial reduction flake, block shatter (n=36), decortification flakes (n=11), and re-sharpening flakes (n=2). In addition to the debitage contained within this cluster there are a few tools including retouched flakes (n=3), one utilized flake and a single endscraper. The cluster also contains one core and four split pebble artifacts. The cluster is made up mainly of small debitage (n=95), as well as smaller amounts of medium (n=24) and large (n=4) debitage. A single micro-debitage flake also exists within the cluster.

Table 6.9 Artifacts contained in cluster MRA4.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	63
	Black Silicified Quartzite	15
	Black Chert	12
	Green Chert	4
	Grey Chert	14

	Heat-altered Quartzite	18
	Sandstone	4
	Salt and Pepper Quartzite	2
	Quartz	3
	Total	**135**
Artifact Type	Flake Fragment	72
	Bifacial Reduction Flake	1
	Block Shatter	36
	Core	1
	Decortification Flakes	11
	Edge Modified (Utilized)	1
	Edge Modified (Retouched)	3
	Endscraper	1
	Split Pebble	4
	Resharpening Flake	5
	Total	**135**
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	95
	Medium Debitage (2.5 to 5 cm)	24
	Large Debitage (over 5 cm)	4
	Unclassified	11
	Total	**135**

Cluster MRA5 (Table 6.10) is comprised of 87 artifacts made from quartzite (n=36), heat-altered quartzite (n=47), heat-altered salt and pepper quartzite (n=1), black chert (n=1), grey chert (n=1), and coarse-grained quartzite (n=1). A total of 5 endscrapers were recovered from within this cluster, as well as flake fragments (n=45), bifacial reduction flakes (n=2), block shatter (n=20), and decortification flakes (n=15). Most of the artifacts are small debitage (n=77), however, medium debitage (n=9), and micro debitage (n=1) were also contained within the cluster.

Table 6.10 Artifacts contained in cluster MRA5.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	36
	Black Chert	1
	Grey Chert	1
	Heat-altered Quartzite	47
	Heat-altered Salt and Pepper Quartzite	1
	Coarse Grained Quartzite	1
	Total	**87**

Artifact Type	Flake Fragment	45
	Bifacial Reduction Flakes	2
	Block Shatter	20
	Decortification Flakes	15
	Endscraper	5
	Total	**87**
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	77
	Medium Debitage (2.5 to 5 cm)	9
	Total	**87**

Cluster MRA6 (Table 6.11) is the largest cluster defined in Block A. It is made up mainly of quartzite artifacts (n=276), of which 16 show evidence of being heat-altered. The cluster also contains grey chert (n=1), Peace Point Chert (n=5), red siltstone (n=1), sandstone (n=4), salt and pepper quartzite (n=1), and quartz (n=1) artifacts. A single utilized flake, one sidescraper, a spall tool, and a uniface are contained within this cluster. Debitage in the cluster consists of flake fragments (n=186), bifacial reduction flakes (n=10), block shatter (n=41), and re-sharpening flakes (n=21). A single core was also contained within the cluster. Most of the artifacts contained in the cluster are small (n=268), but there are also some medium (n=11) and large (n=7) debitage items.

Table 6.11 Artifacts contained in cluster MRA6.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	260
	Grey Chert	1
	Quartz	1
	Salt and Pepper Quartzite	1
	Heat-altered Quartzite	16
	Peace Point Chert	5
	Red Siltstone	1
	Sandstone	4
	Total	**289**
Artifact Type	Flake Fragment	186
	Bifacial Reduction Flake	10
	Block Shatter	41
	Core	1
	Cobble/Spall Tool	1
	Decortification Flakes	26
	Edge Modified (Utilized)	1
	Sidescraper	1

	Uniface	1
	Resharpening Flake	21
	Total	**289**
Size Class	Small Debitage (0.66 to 2.5 cm)	268
	Medium Debitage (2.5 to 5 cm)	11
	Large Debitage (over 5 cm)	7
	Unclassified	3
	Total	**289**

Cluster MRA7 (table 6.12) contains 193 artifacts. A diverse range of lithic materials are represented within the cluster including quartzite (n=112), BRS (n=1), argillite (n=13), grey chert (n=2), quartz (n=41), heat-altered quartzite (n=9), heat altered salt and pepper quartzite (n=1), Peace Point Chert (n=10) and sandstone (n=4). Debitage includes flake fragments (n=93), bifacial reduction flakes (n=2), block shatter (n=54), and re-sharpening flakes (n=10). One utilized flake, a single split pebble and two cobble tools were also contained within cluster MRA7. The artifacts in cluster MRA7 consist of small (n=162), medium (n=25), and large (n=1) debitage.

Table 6.12 Artifacts contained in cluster MRA7.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	112
	BRS	1
	Argillite	13
	Grey Chert	2
	Quartz	41
	Heat-altered Quartzite	9
	Heat-altered Salt and Pepper Quartzite	1
	Peace Point Chert	10
	Sandstone	4
	Total	**193**
Artifact Type	Flake Fragment	93
	Bifacial Reduction Flake	2
	Block Shatter	54
	Decortification Flake	30
	Edge Modified (Utilized)	1
	Split Pebble	1
	Cobble / Spall Tool	2
	Resharpening Flake	10
	Total	**193**
Size Class	Small Debitage (0.66 to 2.5 cm)	162

	Medium Debitage (2.5 to 5 cm)	25
	Large Debitage (over 5 cm)	1
	Unclassified	5
	Total	**193**

Cluster MRA8 (Table 6.13) is one of the smaller clusters in Block A and consists of 16 artifacts. Raw materials from this cluster include quartzite (n=5), coarse grained quartzite (n=4), quartz (n=1), heat-altered quartzite (n=1) and sandstone (n=5). The debitage in the cluster consists of flake fragments (n=4) and block shatter (n=5). Two utilized flakes, one retouched flake, and a cobble tool were contained in the cluster. The cluster is mainly made up of medium debitage (n=24), but also contains lesser amounts of small (n=4) and large (n=3) debitage.

Table 6.13 Artifacts contained in cluster MRA8.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	5
	Coarse Grained Quartzite	4
	Quartz	1
	Heat-altered Quartzite	1
	Sandstone	5
Artifact Type	Flake Fragment	4
	Block Shatter	5
	Edge Modified (Utilized)	2
	Edge Modified (Retouched)	1
	Cobble / Spall Tool	4
Size Class	Small Debitage (0.66 to 2.5 cm)	3
	Medium Debitage (2.5 to 5 cm)	10
	Large Debitage (Over 5 cm)	3

Cluster MRA9 (Table 6.14) contains 104 lithic artifacts. The artifacts are made up of quartzite (n=81), BRS (n=15), black chert (n=1), quartz (n=3), heat-altered quartzite (n=3), and Peace Point Chert (n=1). Debitage includes flake fragments (n=40), bifacial reduction flakes (n=4), block shatter (n=11), re-sharpening flakes (n=42) and decortification flakes (n=6). A single endscraper is included in the cluster, which otherwise consists mainly of small debitage (n=91), with small amounts of micro (n=1) and medium (n=2) debitage.

Table 6.14 Artifacts contained in Cluster MRA9.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	81
	BRS	15

	Black Chert	1
	Quartz	3
	Heat-altered Quartzite	3
	Peace Point Chert	1
	Total	**104**
Artifact Type	Flake Fragment	40
	Bifacial Reduction Flake	4
	Block Shatter	11
	Decortification Flakes	6
	Endscraper	1
	Resharpening Flakes	42
	Total	**104**
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	91
	Medium Debitage (2.5 to 5 cm)	2
	Unclassified	10
	Total	**104**

6.2.2.5 Block A: Hotspot Analysis

The results of the hotspot analysis test for Block A are illustrated in Figure 6.9. A total of five clusters was identified. No additional clusters were identified through hotspot analysis, but several were confirmed. Clusters MRA4, MRA5, MRA6, MRA7, and MRA9 lined up exactly with the hotspots determined through the hotspot analysis test.

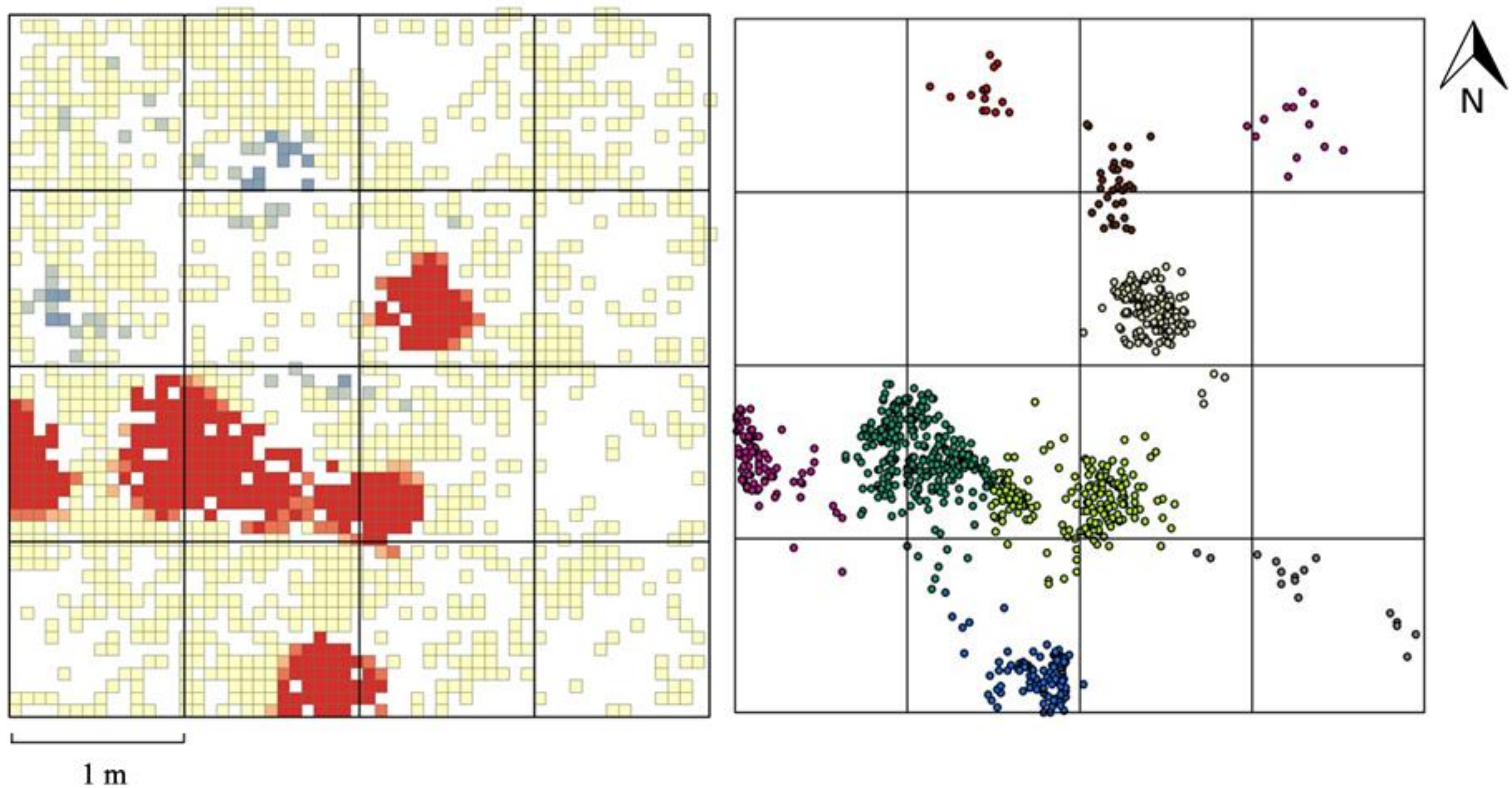


Figure 6.9 Results of the optimized hotspot analysis test (left) compared to the clusters determined through NN analysis, KDE maps, and K-means.

6.2.3 Block A: Refits

A total of eight refits were discovered in the Block A assemblage. Three split pebble artifacts refit together with a single decortification flake, to create a nearly complete pebble. A single piece of block shatter refits onto a core fragment, and two incomplete spall tools refit together as one complete tool. All the refits discovered in Block A were contained within specific defined artifact clusters (Figure 6.10). Most of the refits found in the Block A assemblage were recovered close to one another and from similar depth values. One exception is the refit artifacts from cluster MRA6 which were discovered 67 cm apart horizontally and 8 cm apart vertically.

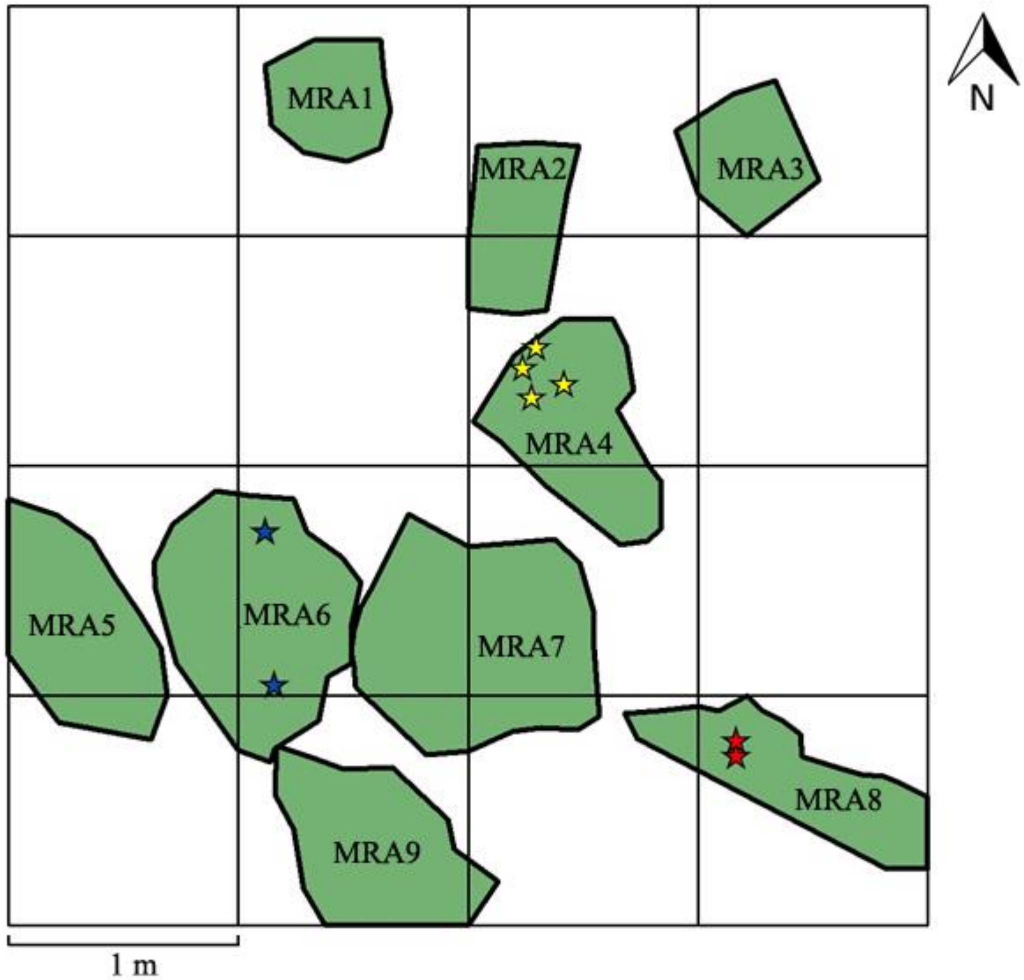


Figure 6.10 Location of refits in Block A in relation to the defined clusters.

6.3 Block B

Block B is located roughly 50 m from the water's edge on a slightly elevated section of the site (Chapter 3, Figure 3.2). The block was deemed to be an area of moderate artifact density, with a total of 756 artifacts recovered from an area measuring 32 m^2 (Ives 1985:45). The artifacts recovered from this block include lithic materials (n=749), faunal remains (n=6), and a single historic artifact. Table 6.17 gives an account of each artifact recovered from the block based on raw material, artifact type, and size class. Ives (1985:165) defined five distinct artifact clusters within the block. According to Ives (1985:107) artifact patterning in Block B was "non-random and exhibits strongly aggregated patterning." Ives concluded that the clusters in Block B were isolated, with little to no cluster overlap.

Table 6.15 Artifacts recovered from Block B according to lithic raw material, artifact type, and size class (note raw material total is without historic artifacts or faunal remains).

Artifact Grouping		Frequency
Raw Material	Argillite	11
	Black Chert	12
	Beaver River Sandstone	13
	Brown Chert	1
	Grey Chert	15
	White Chert	1
	Red Chert	1
	Red Siltstone	2
	Peace Point Chert	21
	Quartz	2
	Sandstone	2
	Salt and Pepper Quartzite	6
	Heat-altered S&P Quartzite	14
	Heat-altered Quartzite	108
	Coarse Grained Quartzite	9
	Quartzite	531
	Total	**749**
Artifact Type	Flake Fragment	524
	Block Shatter	75
	Faunal Remains	6
	Resharpening Flake	36
	Decortification Flake	42
	Edge Modified (Utilized)	5
	Edge Modified (Retouched)	12
	Split Pebble	3
	Core	4
	Projectile Point	4

	Endscraper	7
	Uniface	2
	Biface	3
	Cobble/Spall Tool	1
	Hammerstone	1
	Historic	1
	Bifacial Reduction Flake	29
	Side Scraper	1
	Total	**756**
Size Class	Micro debitage (0 to 0.66 cm)	2
	Small debitage (0.66 to 2.5 cm)	474
	Medium debitage (2.5 to 5 cm)	107
	Large debitage (over 5 cm)	11
	Unclassified	162
	Total	**756**

6.3.1 Visual Assessment of Block B

A preliminary visual assessment of Block B determined that most artifacts did not readily appear to cluster. Most artifact categories contained only a few items and this made any potential spatial relationships difficult to determine. For instance, a total of six endscrapers were recovered from Block B, and while some were recovered in close proximity to one another, it can be difficult to identify a pattern based only on two or three artifacts (Figure 6.11).

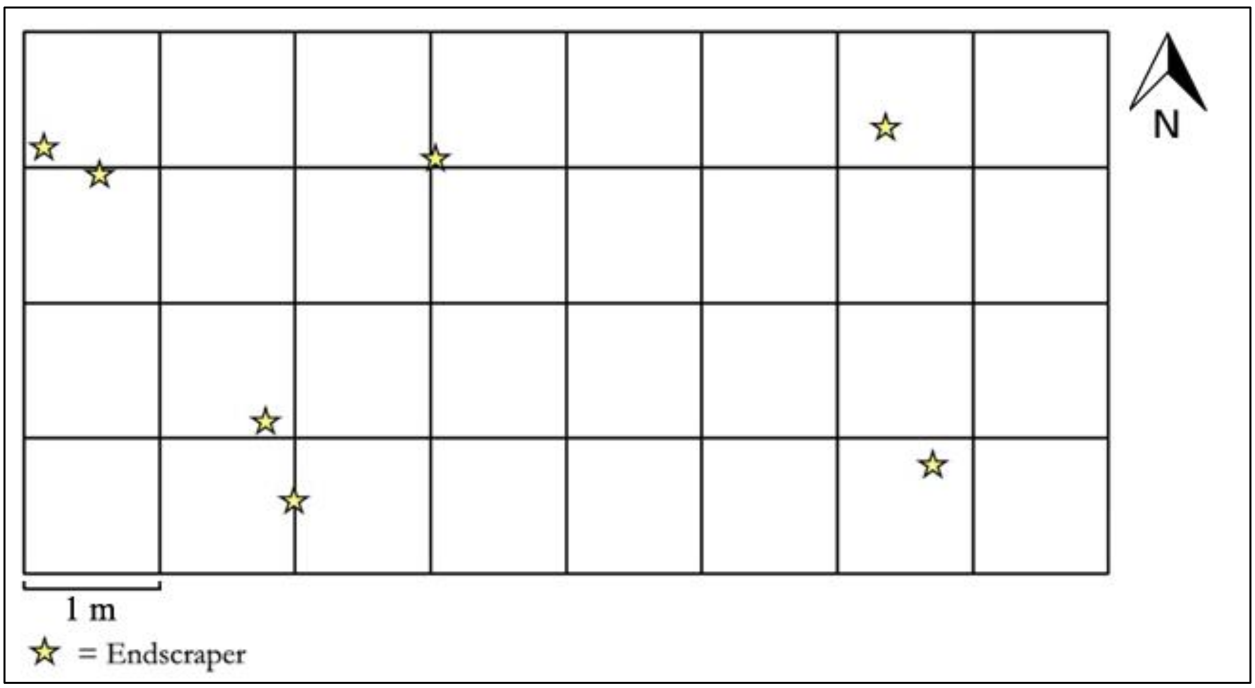


Figure 6.11 Distribution of endscrapers recovered from Block B.

In contrast to Block A, artifact categories which contained a large quantity of artifacts were more likely to show evidence of potential patterning. For example, quartzite artifacts made up approximately 70% of the assemblage in Block B, and pockets of quartzite appeared to be more densely clustered in specific sections of the block (Figure 6.12). Table 6.16 displays a list of which artifacts appeared to be distributed into observable compact clusters and which ones were distributed in such a way that no patterns were recognized. No patterning was noticed in the vertical distribution of artifacts recovered from Block B.

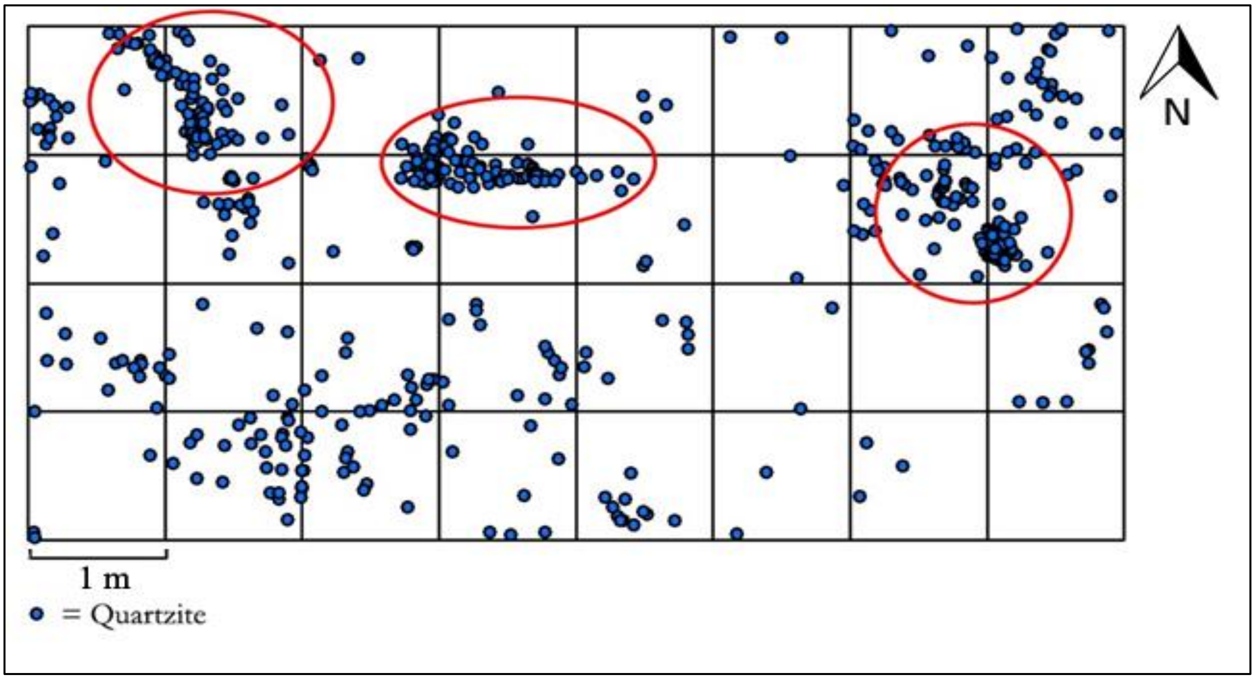


Figure 6.12 Distribution of quartzite artifacts recovered from Block B. Red circles indicate locations of dense concentration.

Table 6.16 Artifacts from Block A appeared to be clustered based on a visual analysis of the artifacts by raw material, type, and size class.

Artifact Grouping	Patterns Observed	No Patterns Observed
Raw Material	Argillite	Black Chert
	Quartzite	Beaver River Sandstone
	Heat-altered Quartzite	Brown Chert
	Heat-altered S&P Quartzite	Grey Chert
		White Chert
		Red Chert
		Red Siltstone
		Peace Point Chert
		Quartz
		Sandstone

		Salt and Pepper Quartzite
		Coarse Grained Quartzite
Artifact Type	Flake Fragment	Block Shatter
	Resharpening Flake	Bifacial Reduction Flakes
	Split Pebble	Decortification Flakes
	Projectile Point	Edge Modified (Utilized)
	Edge Modified (Retouched)	Core
	Faunal Remains	Endscraper
		Uniface
		Biface
		Cobble/Spall Tool
		Hammerstone
		Historic
		Side Scraper
Size Class	Small debitage (0.66 to 2.5 cm)	Micro debitage (0 to 0.66 cm)
		Medium debitage (2.5 to 5 cm)
		Large debitage (over 5 cm)

6.3.2 Statistical Analysis of Block B

A preliminary visual inspection of Block B found that while some of the artifact categories appeared to cluster, the majority did not. A statistical analysis of Block B set out to determine if the observed clusters were valid and to see if any clusters exist within the data that were missed through visual inspection.

6.3.2.1 Block B: Surface Interpolation

A surface interpolation test was conducted for each artifacts class from Block B containing more than one artifact. No test was conducted for brown chert, white chert, red chert, cobble tools, hammerstones, or historic artifacts because each of these categories only contained one artifact class, therefore precluding patterning.

The test determined that a few artifacts were distributed vertically in a patterned fashion. However, most artifacts were randomly distributed between 5 to 40 cmbd. The exceptions were salt and pepper quartzite artifacts, faunal remains, bifaces, and quartz; these were mostly recovered from below 20 cmbd. Split pebble tools on the other hand were all found between 7 to 14 cmbd. However, much of the patterning seen was likely because these artifact classes contained very few artifacts. For instance, only three bifaces were recovered from Block B, all from below 20 cmbd, which might be taken as indicative of a spatial relationship when none actually occurs (a Type I error). Table 6.17 shows which artifacts from Block B displayed vertical patterns and which did not.

Table 6.17 Artifacts which displayed vertical patterning according to the surface interpolation test.

Artifact Grouping	Vertical Patterns Observed	No Vertical Patterns Observed
Raw Material	Salt and Pepper Quartzite	Argillite
	Quartz	Beaver River Sandstone
		Black Chert
		Grey Chert
		Peace Point Chert
		Red Siltstone
		Sandstone
		Heat-altered Salt and Pepper Quartzite
		Heat-altered Quartzite
		Quartzite
		Coarse Grained Quartzite
Artifact Type	Faunal Remains	Flake Fragment
	Biface	Block Shatter
	Split Pebble	Bifacial Reduction Flake
		Resharpening Flake
		Decortification Flake
		Edge Modified (Utilized)
		Edge Modified (Retouched)
		Core
		Projectile Point
		Endscraper
		Uniface
		Sidescraper
Size Class		Micro Debitage (0 to 0.66 cm)
		Small debitage (0.66 to 2.5 cm)
		Medium Debitage (2.5 to 5 cm)
		Large Debitage (over 5 cm)

6.3.2.2 Block B: Nearest Neighbour Analysis

A NN test was conducted for all artifact categories in Block B containing more than one artifact. The results of the test can be seen in Table 6.18. The greatest amount of clustering in Block B was determined to be based on the distribution of artifacts by raw material. A few of the artifact categories which appeared to cluster based on the visual inspection of the data were determined by the NN test to be distributed randomly. For instance, according to the NN test, the distribution of projectile points in the block is random, although three of the four projectile points recovered were found within centimeters of each other (Figure 6.13). This result could be an error with the NN test, due to a small sample size, as the three projectile points that were found close together are also stylistically similar (a Type II error).

Table 6.18 Results of the NN test for Block B based on each artifact raw material, artifact type, and size class.

Artifact Grouping	Clustered	Random
Raw Material	Argillite	Beaver River Sandstone
	Grey Chert	Black Chert
	Peace Point Chert	Red Siltstone
	Quartzite	Quartz
	Coarse Grained Quartzite	Sandstone
	Heat-altered Quartzite	Heat-altered Salt and Pepper Quartzite
	Salt and Pepper Quartzite	
Artifact Type	Flake Fragment	Faunal Remains
	Block Shatter	Decortification Flake
	Bifacial Reduction Flake	Edge Modified (Utilized)
	Resharpening Flake	Edge Modified (Retouched)
	Split Pebble	Core
		Projectile Point
		Endscraper
		Uniface
		Biface
		Sidescraper
Size Class	Small Debitage (0.66 to 2.5 cm)	Micro Debitage (0 to 0.66 cm)
		Medium Debitage (2.5 to 5 cm)
		Large Debitage (over 5 cm)

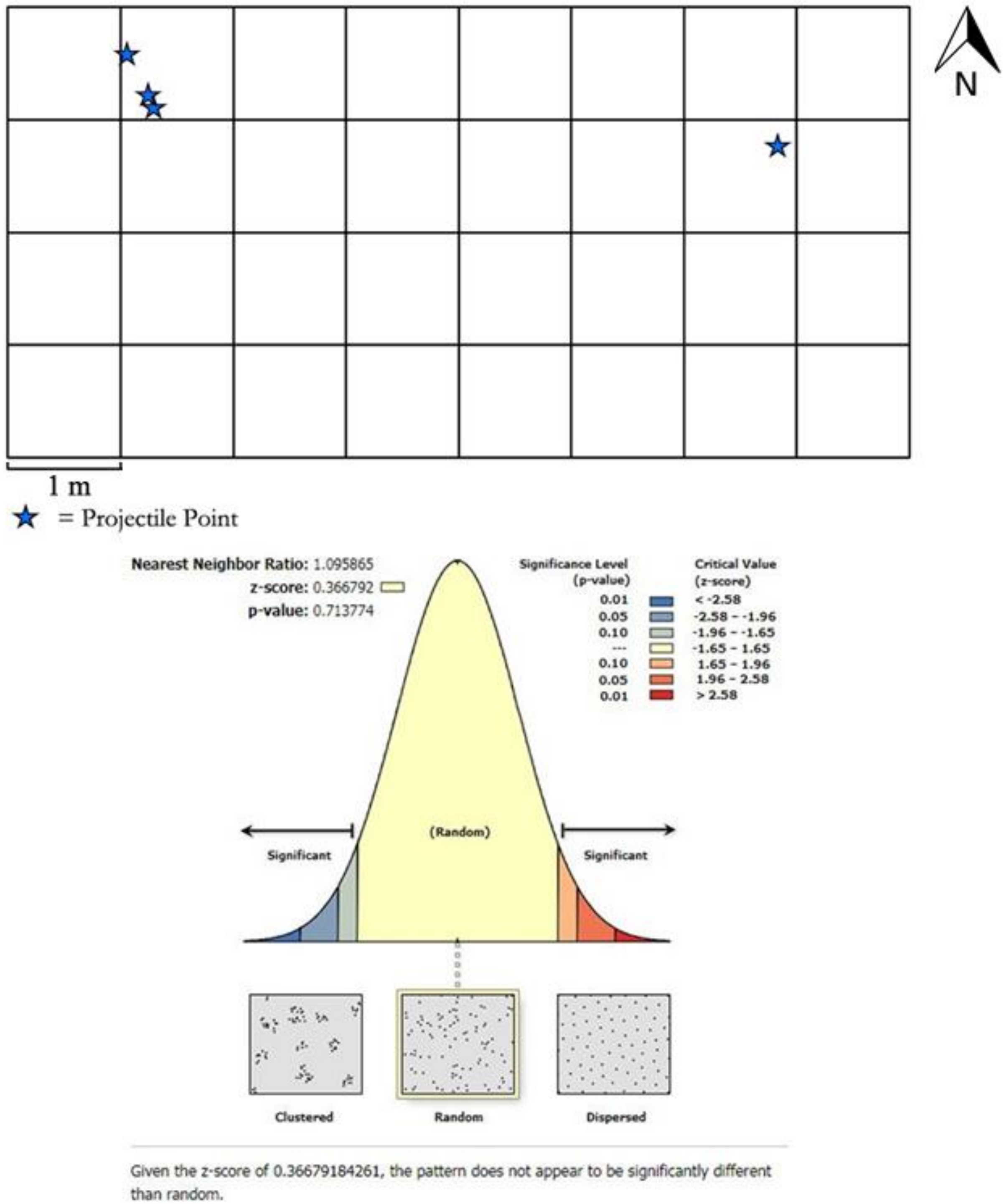


Figure 6.13 NN results for projectile points recovered from Block B

The NN test determined that when grouped by raw material, 7 of the 16 different categories showed signs of being strongly clustered. Only 5 of the 15 different artifact types were determined to be clustered while 10 were randomly distributed. In terms of size class, only small debitage was determined to be clustered.

6.3.2.3 Block B: Kernel Density Estimation

Because the NN test determined that clusters exist within the Block B assemblage, KDE maps were created for each clustered artifact group to determine where the clusters were located. Figure 6.14 shows an example of a KDE map generated for flake fragments recovered from Block B. Each of the artifacts that fell within the designated hotspots according to the KDE maps were combined into a single shape file. Of the 756 artifacts recovered from Block B, 344 were included within the clustered dataset. Table 6.19 displays which artifacts were located within the designated hotspots and Figure 6.15 shows how they were distributed throughout the block.

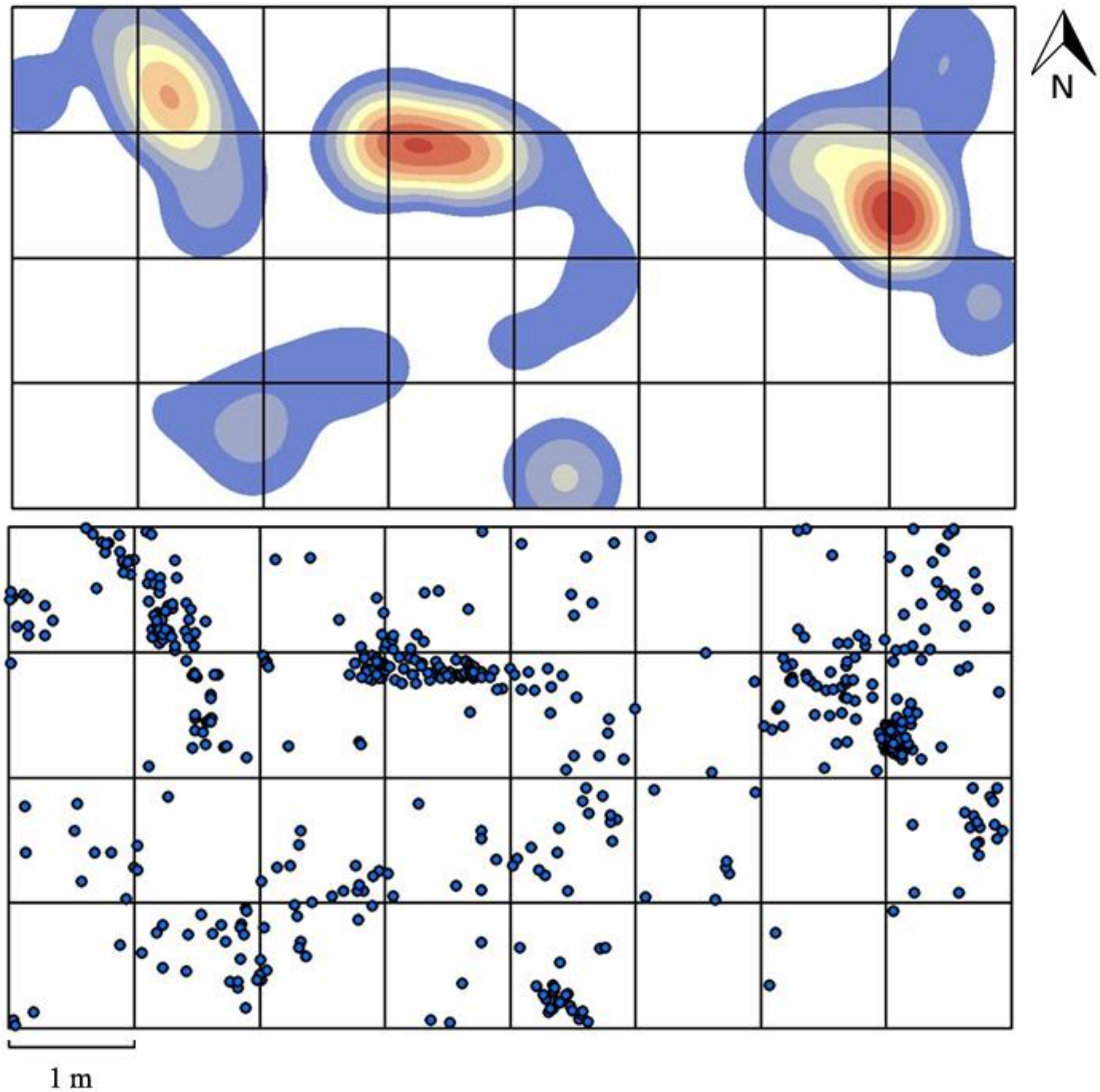


Figure 6.14 KDE map created for flake fragments recovered from Block B.

Table 6.19 Artifacts from Block B that were included in the clustered dataset, grouped by raw material, artifact type, and size class.

Artifact Grouping		Frequency
Raw Material	Argillite	10
	Black Chert	5
	Grey Chert	9
	Red Chert	1
	Peace Point Chert	11
	Salt and Pepper Quartzite	2
	Heat-altered S&P Quartzite	4
	Heat-altered Quartzite	45
	Coarse Grained Quartzite	6
	Quartzite	251
	Total	**344**
Artifact Type	Flake Fragment	258
	Block Shatter	21
	Resharpening Flake	24
	Decortification Flake	13
	Edge Modified (Utilized)	1
	Edge Modified (Retouched)	2
	Split Pebble	3
	Core	1
	Projectile Point	4
	Endscraper	1
	Biface	1
	Bifacial Reduction Flake	15
	Total	**344**
Size Class	Micro debitage (0 to 0.66 cm)	1
	Small debitage (0.66 to 2.5 cm)	222
	Medium debitage (2.5 to 5 cm)	24
	Large debitage (over 5 cm)	1
	Unclassified	96
	Total	**344**

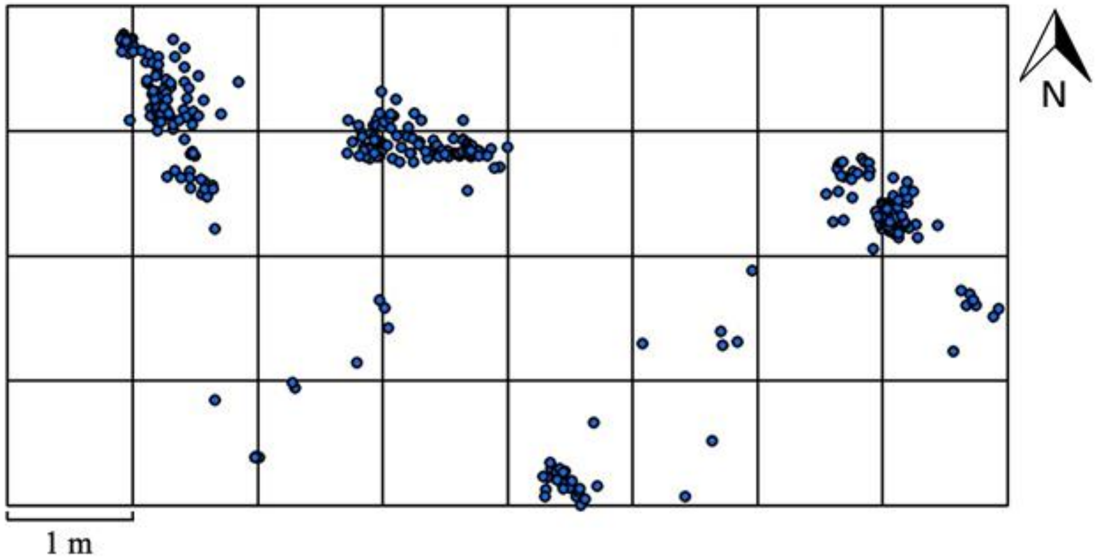


Figure 6.15 Distribution of artifacts from Block B that fell within the clustered dataset according to NN analysis and KDE maps.

6.3.2.4 Block B: K-Means

Once the clustered dataset was determined for Block B, the K-means algorithm was applied to determine cluster membership for each artifact. Using the elbow method (Chapter 5, Section 5.3.5.4) it was determined that 5 clusters are contained within the Block B dataset. Figure 6.16 shows how these clusters are distributed throughout Block B. Clusters were consecutively labelled MRB1 through MRB5.

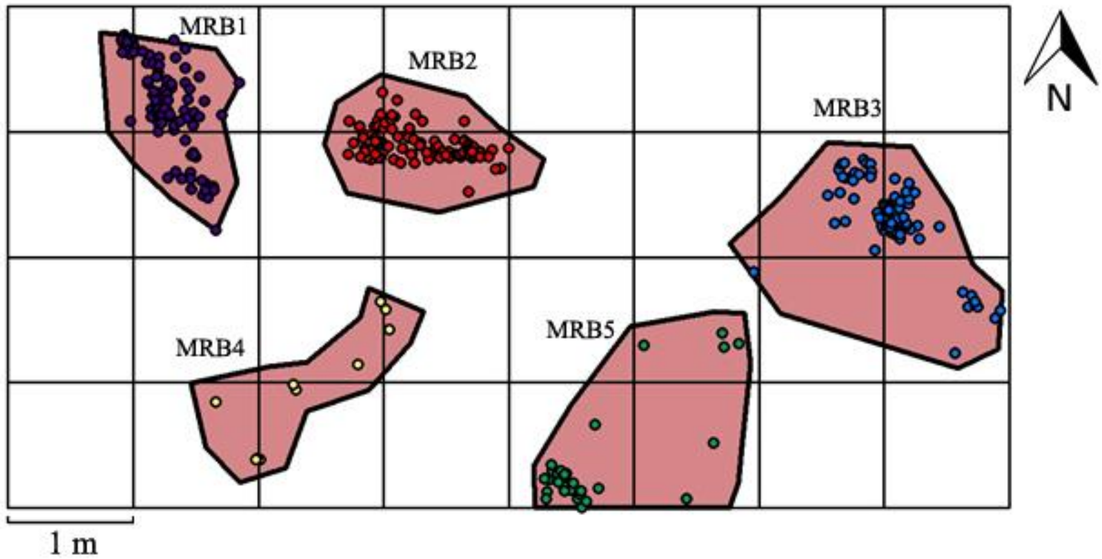


Figure 6.16 Distribution of clusters in Block B as determined through the K-means algorithm.

Cluster MRB1 (Table 6.20) contains a total of 101 lithic artifacts. This includes artifacts made of quartzite (n=75), heat-altered quartzite (n=8), salt and pepper quartzite (n=1), heat-altered salt and pepper quartzite (n=4), black chert (n=2), grey chert (n=5), and Peace Point Chert (n=6). Two side-notched projectile points and the base of one corner-notched projectile point are contained within cluster MRB1. One biface, one utilized flake, and a single retouched flake are also within the cluster. Debitage includes flake fragments (n=58), block shatter (n=13), decortification flakes (n=8), and re-sharpening flakes (n=16). Small debitage (n=83) comprises most of the artifacts in the cluster, but some medium (n=10) and large debitage (n=1) are also included.

Table 6.20 Artifacts contained in Cluster MRB1.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	75
	Black Chert	2
	Grey Chert	5
	Salt and Pepper Quartzite	1
	Heat-altered Quartzite	8
	Heat-altered Salt and Pepper Quartzite	4
	Peace Point Chert	6
	Total	**101**
Artifact Type	Flake Fragment	58
	Biface	1
	Block Shatter	13

	Decortification Flakes	8
	Edge Modified (Utilized)	1
	Edge Modified (Retouched)	1
	Projectile Point	2
	Projectile Point (base)	1
	Resharpening Flakes	16
	Total	**101**
Size Class	Small Debitage (0.66 to 2.5 cm)	83
	Medium Debitage (2.5 to 5 cm)	10
	Large Debitage (Over 5 cm)	1
	Unclassified	7
	Total	**101**

Cluster MRB2 (Table 6.21) consists of 109 lithic artifacts made from argillite (n=1), quartzite (n=99), heat-altered quartzite (n=7), salt and pepper quartzite (n=1), and Peace Point Chert (n=1). A single endscraper and one core are contained within this cluster. Debitage includes flake fragments (n=98), block shatter (n=4), bifacial reduction flakes (n=2), and re-sharpening flakes (n=3). Most of the physical artifacts contained within cluster MRB2 were lost from the assemblage and as such their size could not be determined, but micro debitage (n=1), small debitage (n=24), and medium debitage (n=2) were present.

Table 6.21 Artifacts contained in Cluster MRB2.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	99
	Argillite	1
	Salt and Pepper Quartzite	1
	Heat-altered Quartzite	7
	Peace Point Chert	1
	Total	**109**
Artifact Type	Flake Fragment	98
	Block Shatter	4
	Core	1
	Endscraper	1
	Bifacial Thinning Flake	2
	Resharpening Flakes	3
	Total	**109**
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	24
	Medium Debitage (2.5 to 5 cm)	2
	Unclassified	82
	Total	**109**

Cluster MRB3 (Table 6.22) yielded 93 artifacts including those of argillite (n=9), quartzite (n=77), heat-altered quartzite (n=5), grey chert (n=1), and red chert (n=1). A single quartzite projectile point was contained in the cluster. Ives (1985:87) describes the point as a square-based lanceolate point. Ives (2017) believes this point resembles materials recovered from Component II in Dry Creek, Alaska (Chapter 4, Section 4.3.1; Chapter 7, Section 7.5.3). One core and two retouched flakes were also included in this cluster. The debitage from the cluster consists of flake fragments (n=80), bifacial reduction flakes (n=5), and block shatter (n=2). Most of the artifacts in this cluster were small debitage (n=81), but medium debitage was also present (n=4).

Table 6.22 Artifacts contained in Cluster MRB3.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	77
	Argillite	9
	Grey Chert	1
	Red Chert	1
	Heat-altered Quartzite	5
	Total	**93**
Artifact Type	Flake Fragment	80
	Bifacial Thinning Flakes	5
	Block Shatter	2
	Decortification Flakes	2
	Edge Modified (Retouched)	2
	Core	1
	Projectile Point	1
	Total	**93**
Size Class	Small Debitage (0.66 to 2.5 cm)	81
	Medium Debitage (2.5 to 5 cm)	5
	Unclassified	7
	Total	**93**

Cluster MRB4 (Table 6.23) is a small cluster of only 10 artifacts. Peace Point Chert (n=4) and coarse-grained quartzite (n=6) are contained within the cluster. Flake fragments (n=5), block shatter (n=1), a decortification flake (n=1) and a re-sharpening flake (n=1) make up the debitage in the cluster. The artifacts in cluster MRB4 consist of small debitage (n=7) and medium debitage (n=3).

Table 6.23 Artifacts contained in Cluster MRB4.

Artifact Grouping	Type	Frequency
Raw Material	Coarse Grained Quartzite	6
	Peace Point Chert	4
	Total	**10**
Artifact Type	Flake Fragment	5
	Block Shatter	1
	Decortification Flake	1
	Resharpening Flake	3
	Total	**10**
Size Class	Small Debitage (0.66 to 2.5 cm)	7
	Medium Debitage (2.5 to 5 cm)	3
	Total	**10**

Cluster MRB5 (Table 6.24) is a cluster of 32 artifacts. Quartzite (n=1), heat-altered quartzite (n=25), black chert (n=3) and grey chert (n=3) are present in the cluster. The cluster contains split pebble artifacts (n=3) as well as flake fragments (n=17), bifacial reduction flakes (n=8), block shatter (n=1), decortification flakes (n=2), and a re-sharpening flake (n=1). The artifacts within the cluster consist of small (n=27) and medium debitage (n=5).

Table 6.24 Artifacts contained in Cluster MRB5.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	1
	Black Chert	3
	Grey Chert	3
	Heat-altered Quartzite	25
	Total	**32**
Artifact Type	Flake Fragment	17
	Bifacial Thinning Flake	8
	Block Shatter	1
	Decortification Flake	2
	Resharpening Flake	1
	Split Pebble	3
	Total	**32**
Size Class	Small Debitage (0.66 to 2.5 cm)	27
	Medium Debitage (2.5 to 5 cm)	5
	Total	**32**

6.3.2.5 Block B: Hot Spot Analysis

The results of the hot spot analysis test for Block B are shown in Figure 6.17. A total of 3 clusters were defined through the hot spot analysis test. No additional clusters were discovered beyond the ones that were already defined. The hot spot analysis test confirmed the presence of three of the defined clusters. Clusters MRB1, MRB2, and MRB3 line up with the clusters defined through hotspot analysis.

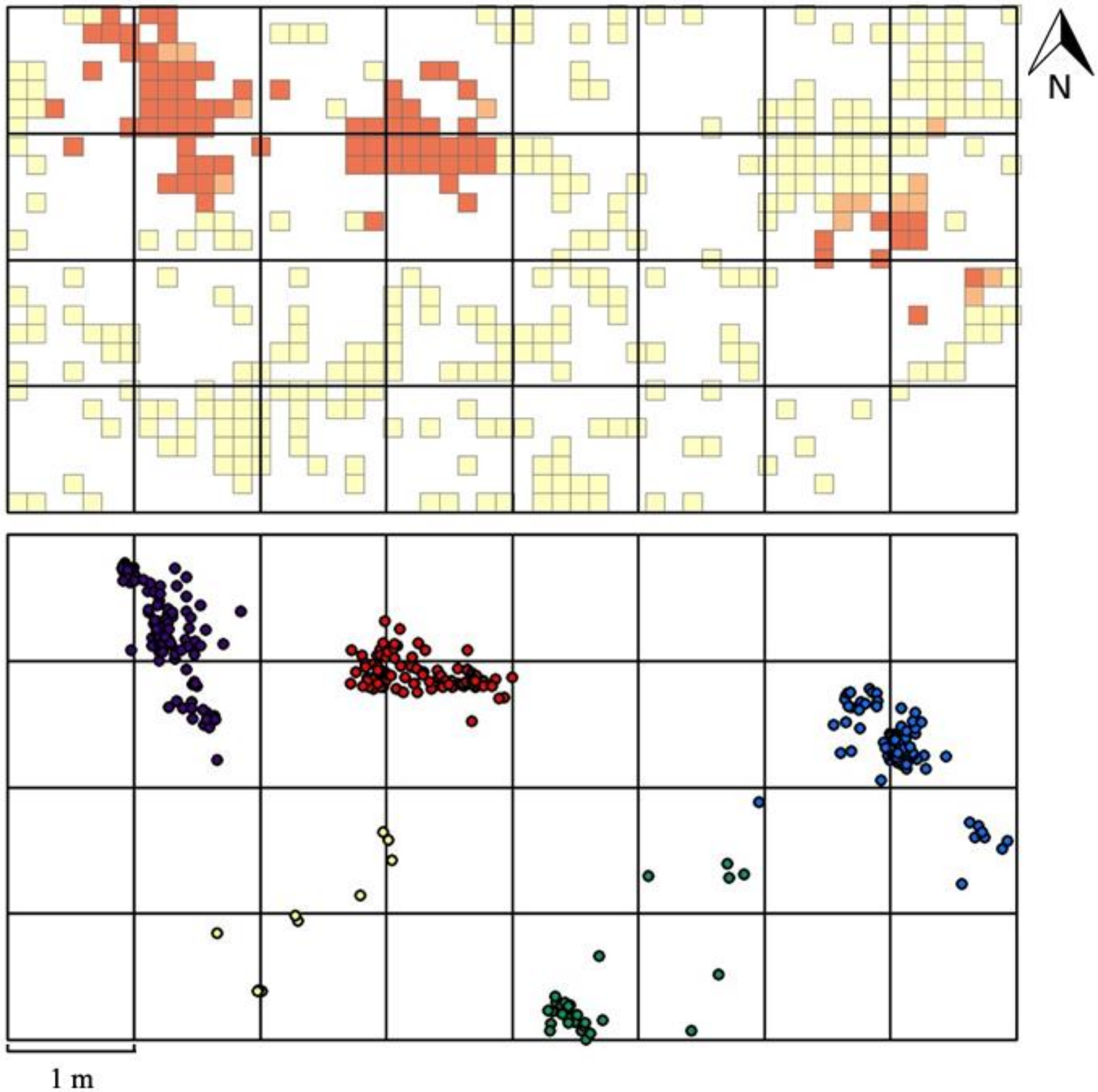


Figure 6.17 Results of the optimized hotspot analysis test (top) compared to the clusters determined through NN analysis, KDE maps, and K-Means (bottom).

6.3.3 Block B: Refits

Several refits were discovered in the Block B artifact assemblage (Figure 6.18). All the refit artifacts consist of flake fragments that were found close to each other. In terms of vertical depth, each of the artifacts that refit were recovered from similar depths. The greatest difference in terms of depth were two refit artifacts that were recovered at 9 and 12 cmbd respectively. Two sets of refit artifacts fell within cluster MRB3 while the rest of the refit artifacts fell outside of any defined clusters.

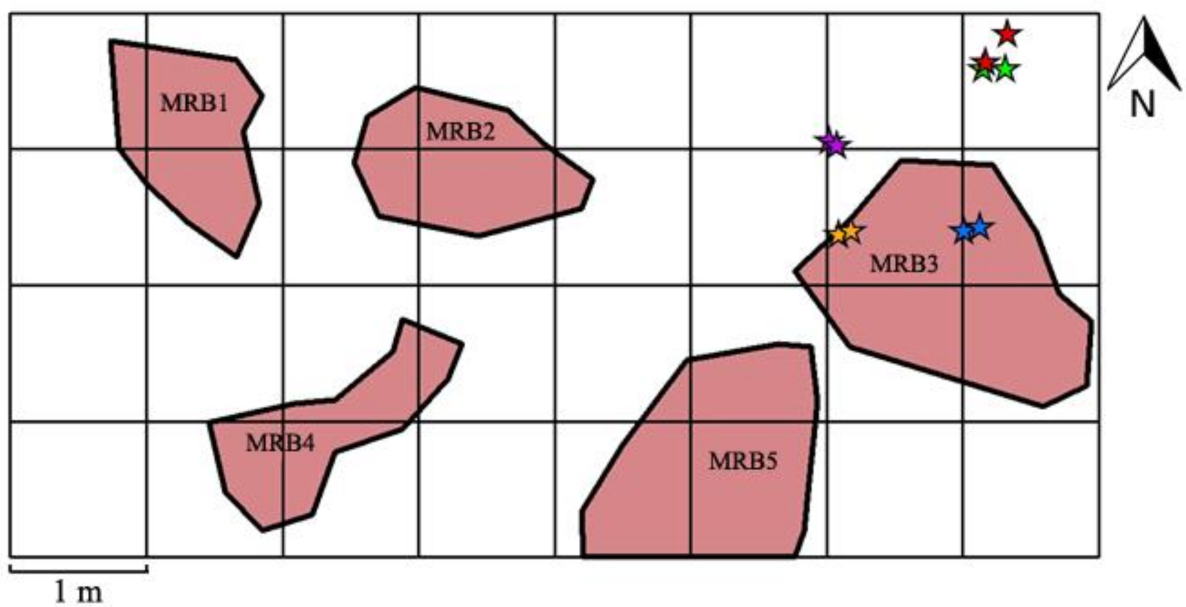


Figure 6.18 Location of refits in Block B in relation to the defined clusters.

6.4 Block C

Block C is located in the northwestern-most section of the site, on an area of high elevation (Chapter 3, Figure 3.2). The block is considered an area of high artifact density with 2112 artifacts recovered from an area measuring 32 m^2 (Ives 1985:45). The assemblage from this block is mostly composed of lithic artifacts (n=2002) with small amounts of faunal remains (n=8) and bone tools (n=2) interspersed. Table 6.25 displays a list of the artifacts recovered from Block C according to lithic raw material type, artifact type, and size class. Ives (1985:107) concluded that the eastern half of the block showed no significant patterning, while the western half is weakly to moderately patterned. A total of eight spatial clusters were defined by Ives in the western half of Block C (Ives 1985:107).

Table 6.25 Artifacts recovered from Block B according to lithic raw material, artifact type, and size class (note raw material total is without bone tools or faunal remains).

Artifact Grouping		Frequency
Raw Material	Argillite	22
	Black Chert	41
	Beaver River Sandstone	171
	Grey Chert	41
	White Chert	6
	Red Chert	1
	Peace Point Chert	71
	Quartz	7
	Salt and Pepper Quartzite	25
	Heat-altered S&P Quartzite	48
	Heat-altered Quartzite	285
	Coarse Grained Quartzite	12
	Quartzite	1372
	Total	**2102**
Artifact Type	Flake Fragment	1370
	Block Shatter	241
	Faunal Remains	8
	Bone Tools	2
	Resharpening Flake	89
	Decortification Flake	139
	Edge Modified (Utilized)	14
	Edge Modified (Retouched)	34
	Split Pebble	4
	Core	4
	Projectile Point	8
	Endscraper	13
	Biface	3
	Cobble/Spall Tool	5
	Hammerstone	1
	Wedge	1
	Bifacial Reduction Flake	174
	Core Rejuvenation Flake	2
	Total	**2112**
Size Class	Micro Debitage (0 to 0.66 cm)	8
	Small Debitage (0.66 to 2.5 cm)	1599
	Medium Debitage (2.5 to 5 cm)	294
	Large Debitage (over 5 cm)	21
	Unclassified	190
	Total	**2112**

6.4.1 Visual Assessment of Block C

A visual assessment of the horizontal distribution of artifacts recovered from Block C determined that when grouped by raw material, about half of the lithics were distributed in such a way that potential patterns were noticed. However, when grouped by artifact type or size class, very little patterning was observed. BRS, Peace Point Chert, black chert, and re-sharpening flakes were all highly aggregated in a large cluster seen in the southeast section of the block (Figure 6.19). A second pattern of significance was noted in the distribution of salt and pepper quartzite. This material was primarily recovered from the north end of the block in and around a cluster of heat-altered materials and bone (Figure 6.20).

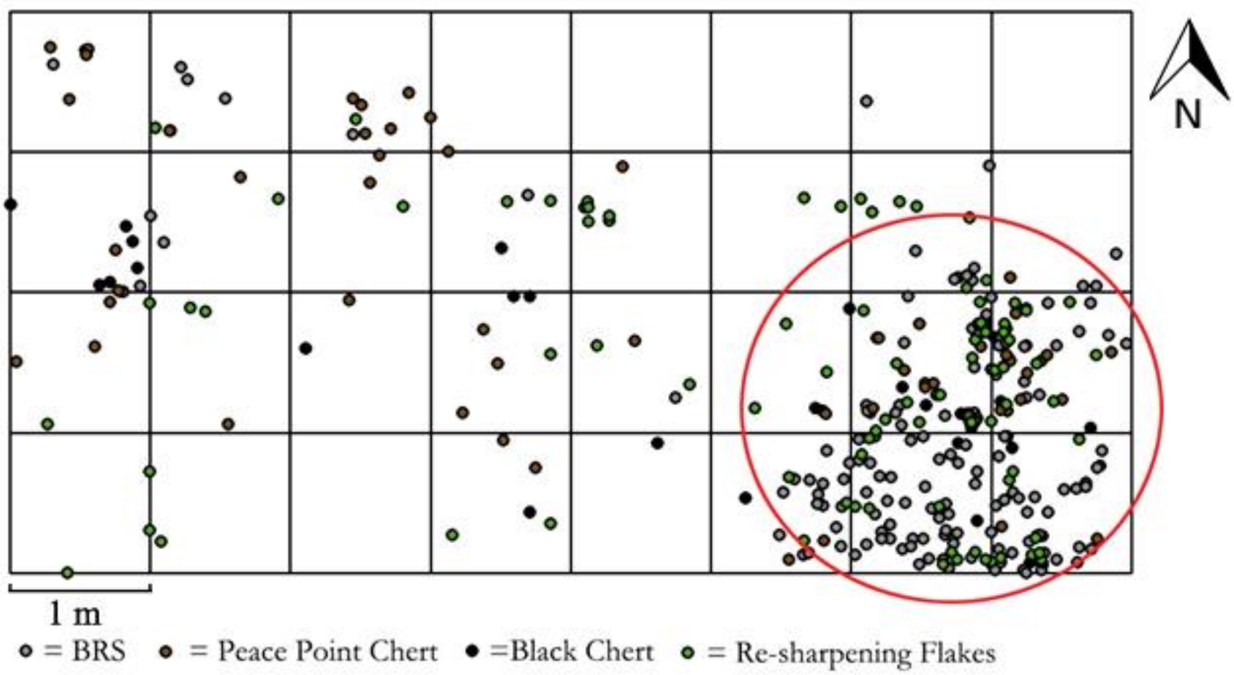


Figure 6.19 The distribution of BRS, Peach Point Chert, black chert, and re-sharpening flakes in Block C (red circle).

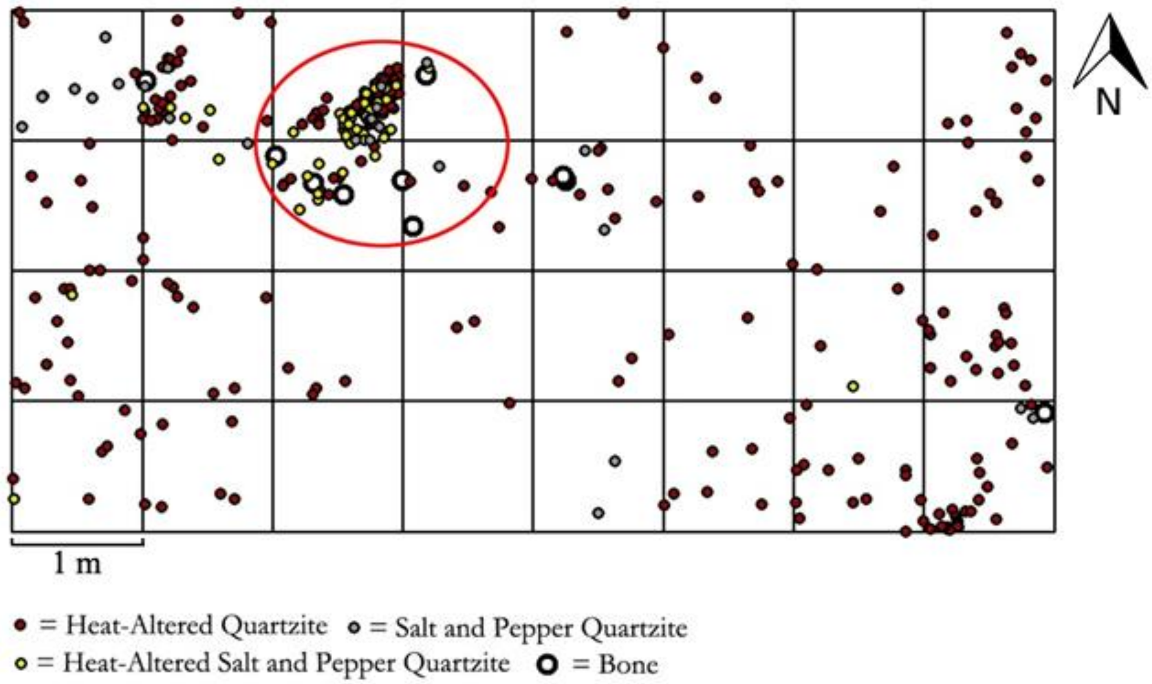


Figure 6.20 The distribution of salt and pepper quartzite, heat-altered quartzite, heat-altered salt and pepper quartzite, and bone in Block C (red circle).

A visual examination of the vertical distribution of artifacts determined that two artifact clusters appeared to occur at greater depth than most other artifacts in the block (Figure 6.21). A closer examination of the clusters determined that one of them was the same cluster of heated materials noted in the horizontal distribution of artifacts (Figure 6.20). Other than this, no meaningful vertical patterns were noted in the distribution of artifacts recovered from Block C. Table 6.26 outlines which artifacts from the block appeared to be spatially clustered and which artifact categories were distributed in such a way that no patterns were observed.

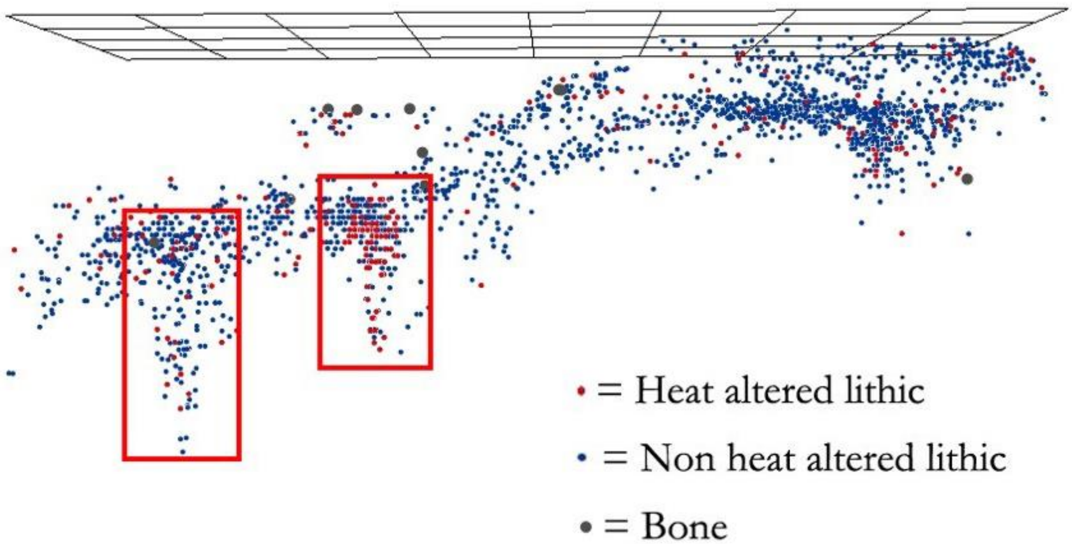


Figure 6.21 Vertical distribution of lithic artifacts and bone recovered from Block C. Two of the artifact clusters appeared deeper than the rest of the artifacts in the block (red rectangles).

Table 6.26 Artifact groups that appeared to be clustered in Block C based solely on visual analysis of the artifact groupings.

Artifact Grouping	Patterns Observed	No Patterns Observed
Raw Material	Argillite	Grey Chert
	Black Chert	Red Chert
	Beaver River Sandstone	White Chert
	Peace Point Chert	Coarse Grained Quartzite
	Salt and Pepper Quartzite	Quartz
	Heat-altered Quartzite	Quartzite
	Heat-altered S&P Quartzite	
Artifact Type	Endscraper	Flake Fragment
	Faunal Remains	Block Shatter
	Resharpening Flake	Decortification Flake
	Bifacial Reduction Flake	Core Rejuvenation Flake
		Edge Modified (Utilized)
		Edge Modified (Retouched)
		Core
		Split Pebble
		Cobble/Spall Tool
		Projectile Point

		Wedge
		Bone tools
		Biface
		Hammerstone
Size Class		Micro debitage (0 to 0.66 cm)
		Small debitage (0.66 to 2.5 cm)
		Medium debitage (2.5 to 5 cm)
		Large debitage (over 5 cm)

6.4.2 Statistical Analysis of Block C

The preliminary visual inspection of Block C found that when grouped by raw material, many artifacts recovered appeared to be clustered. However, only a few clusters were noted when artifacts were grouped by type or size class. A statistical analysis of Block C set out to determine if the clusters observed were valid and to ensure that no clusters exist within the data that were missed through visual inspection.

6.4.2.1 Block C: Surface Interpolation

A surface interpolation test was conducted for all artifact categories in Block C containing more than one artifact. As such, no test was conducted for red chert, hammerstones or wedges. The only artifacts to show vertical distribution patterns in Block C were faunal remains. All bone artifacts recovered from the site were found no deeper than 20 cmbd. In contrast, all other artifact categories were distributed randomly anywhere between 5 to 50 cmbd.

6.4.2.2 Block C: Nearest Neighbour Analysis

A NN test was conducted for each artifact category in Block C containing more than one artifact. The test confirmed that clusters exist within the data that were not observed through visual inspection. For instance, no patterns were seen in the distribution of decortification flakes; however, the NN test determined their distribution to be significantly clustered (Figure 6.22). Additionally, some patterns noted through visual assessment were not identified by the NN test. For example, while bone artifacts recovered from Block C visually appeared to be clustered mainly in the north end of the block, the NN test deemed the distribution of these artifacts to be random (Figure 6.23). Table 6.27 shows which artifacts were random or clustered according to the NN test.

Table 6.27 Results of the NN test for Block C based on each artifact raw material, artifact type, and size class.

Artifact Grouping	Clustered	Random
Raw Material	Argillite	Coarse Grained Quartzite
	Black Chert	Quartz
	BRS	White Chert
	Grey Chert	
	Heat-altered Quartzite	
	Heat-altered S&P Quartzite	
	Peace Point Chert	
	Salt and Pepper Quartzite	
Artifact Type	Bone Tool	Biface
	Bifacial Reduction Flake	Core Rejuvenation Flake
	Decortification Flake	Core
	Flake Fragment	Endscrapers
	Resharpening Flake	Projectile Point
	Block Shatter	Edge Modified (Utilized)
	Cobble/Spall Tool	Edge Modified (Retouched)
		Split Pebble
		Faunal Remains
Size Class	Small debitage (0.66 to 2.5 cm)	Micro debitage (0 to 0.66 cm)
	Medium debitage (2.5 to 5 cm)	Large debitage (over 5 cm)

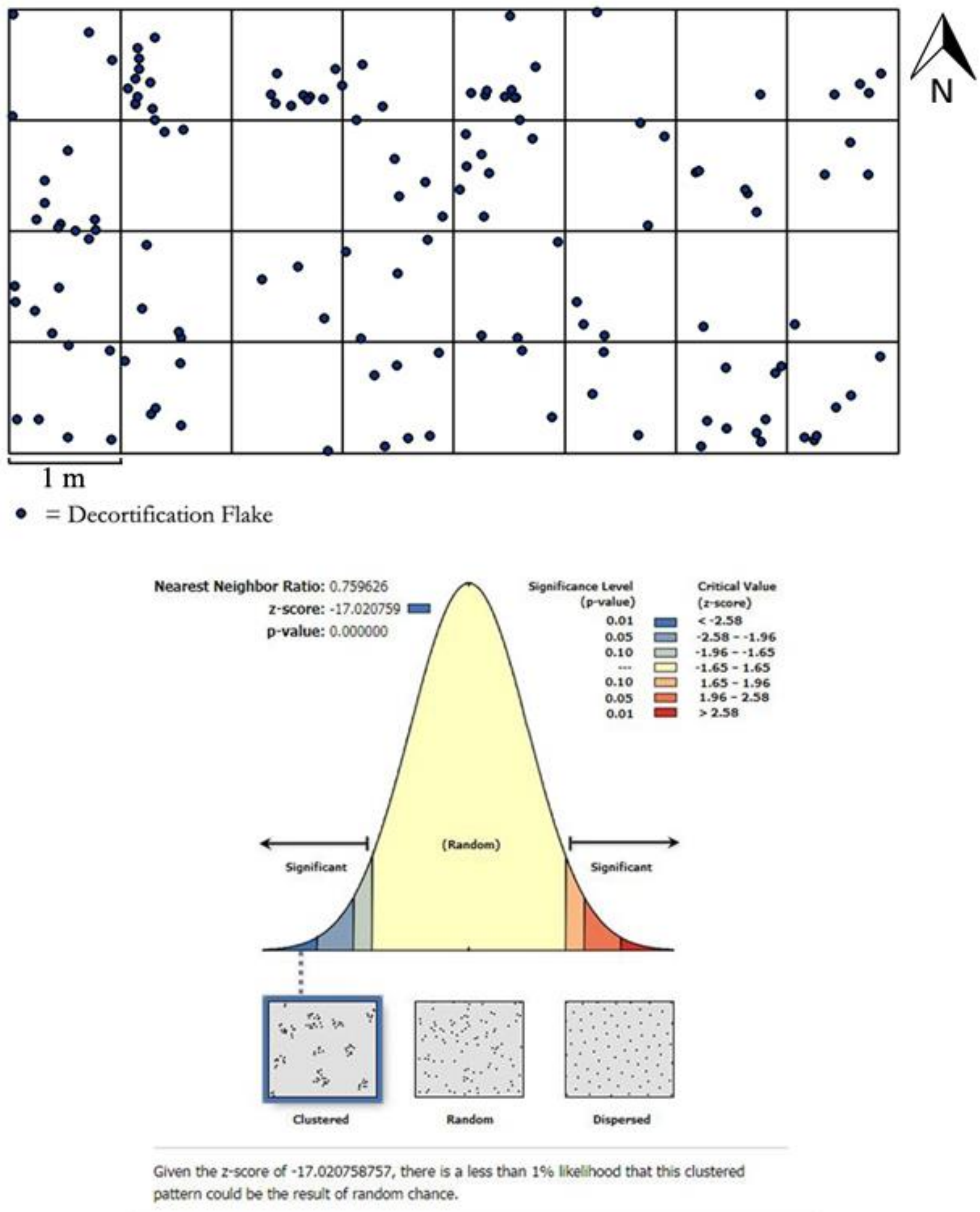
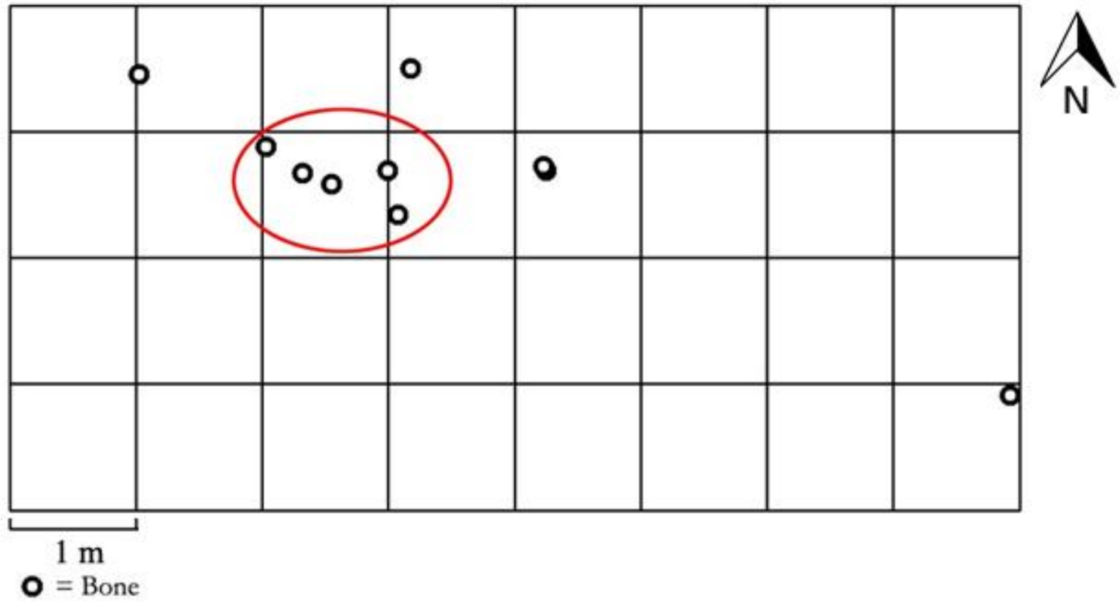


Figure 6.22 NN results for decortification flakes recovered from Block C.



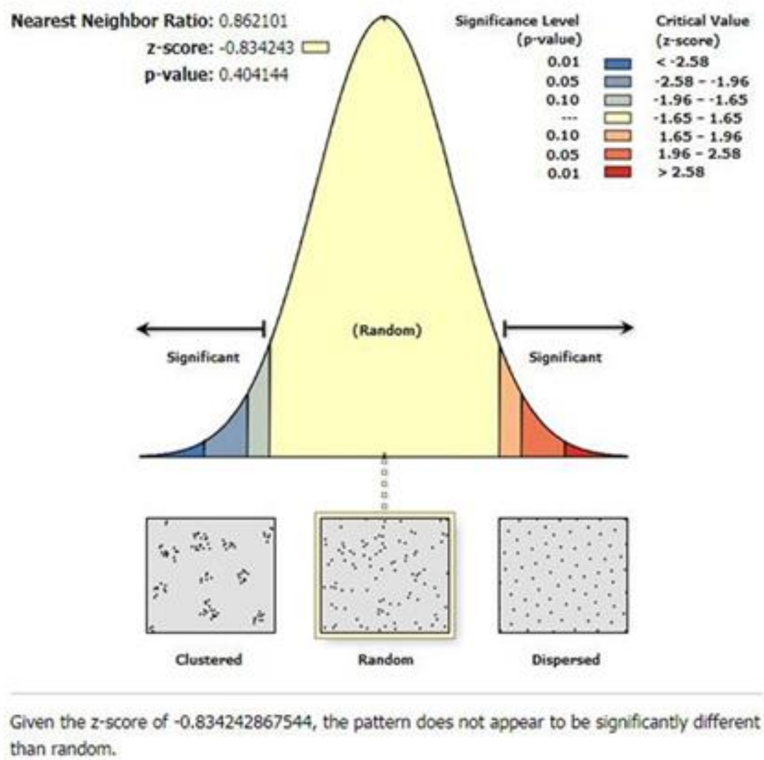


Figure 6.23 Despite appearing to be clustered, the NN output determined that bone artifacts recovered from Block C were in fact, randomly distributed.

The NN test determined that when grouped by raw material 8 of the 11 material types were statistically clustered. A total of 7 out of 16 artifact types were determined to be clustered, and only small and medium debitage were clustered in the block.

6.4.2.3 Block C: Kernel Density Estimation

The results of the NN test determined that many of the artifacts recovered from Block C were statistically clustered. KDE maps were generated for each clustered artifact group. Figure 6.24 shows an example of the KDE map generated for decortification flakes. All the artifacts that fell within the defined hotspots were combined into a single shapefile. Of the 2112 artifacts recovered in Block C, 681 were included in the clustered dataset. Table 6.28 shows which artifacts were located within the designated hotspots and Figure 6.27 displays how they were distributed throughout the block.

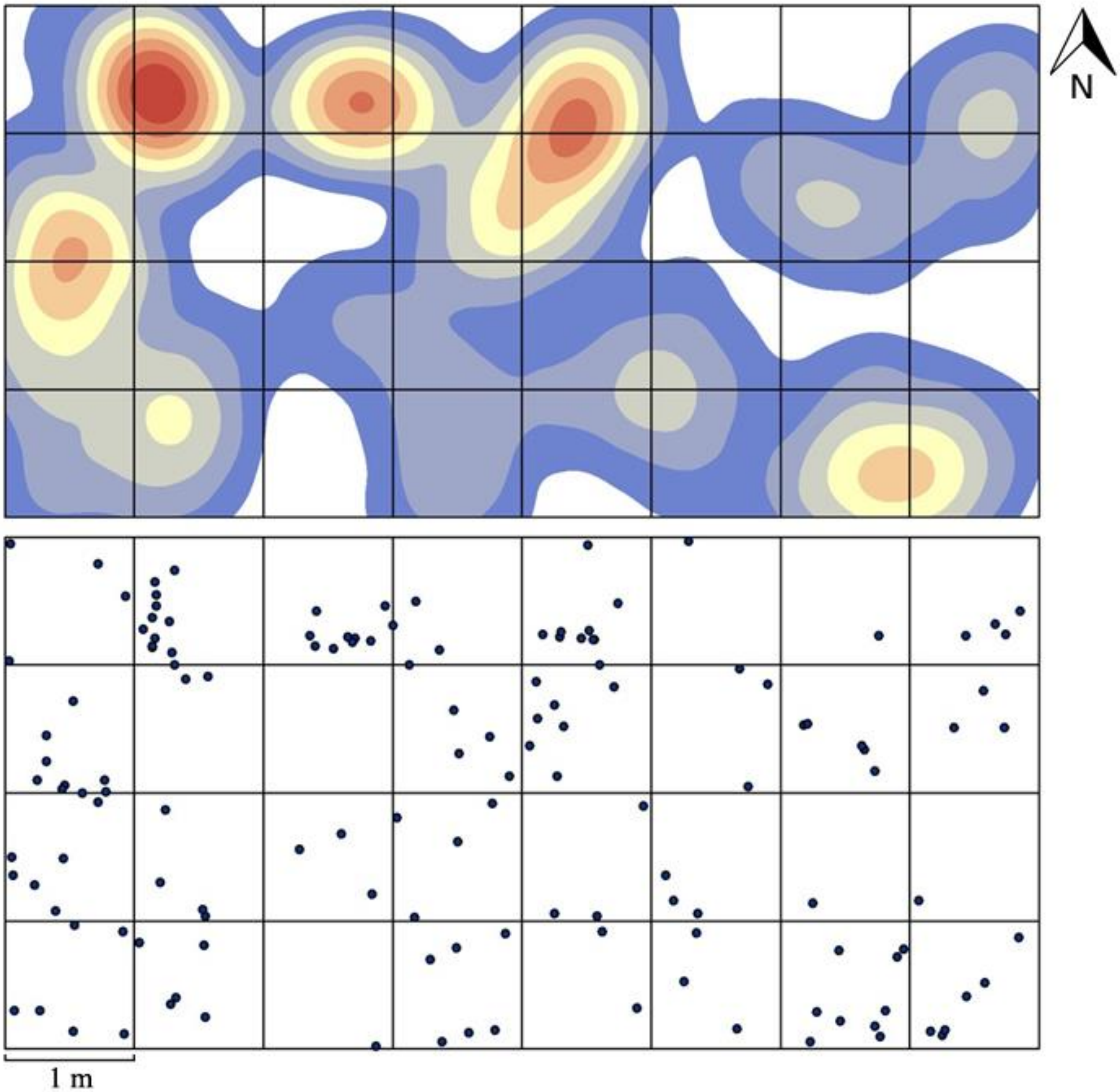


Figure 6.24 KDE map created for decortification flakes recovered from Block C.

Table 6.28 Artifacts from Block C that were included in the clustered dataset, grouped by raw material, artifact type, and size class (Note raw material total is without bone tools).

Artifact Grouping		Frequency
Raw Material	Argillite	11
	Beaver River Sandstone	71
	Grey Chert	22
	White Chert	2
	Black Chert	18
	Peace Point Chert	42
	Quartz	1
	Quartzite	349
	Heat-altered Quartzite	110
	Salt and Pepper Quartzite	16
	Heat-altered S&P Quartzite	32
	Coarse Grained Quartzite	4
	Total	**678**
Artifact Type	Flake Fragment	396
	Block Shatter	64
	Bifacial Reduction Flake	90
	Decortication Flake	63
	Re-sharpening Flake	40
	Bone Tools	2
	Edge Modified (Utilized)	6
	Edge Modified (Retouched)	5
	Endscraper	4
	Cobble/Spall Tool	4
	Projectile Point	1
	Core	2
	Split Pebble	3
	Total	**680**
Size Class	Micro Debitage (0 to 0.66 cm)	3
	Small Debitage (0.66 to 2.5 cm)	546
	Medium Debitage (2.5 to 5 cm)	104
	Large Debitage (Over 5 cm)	5
	Unclassified	22
	Total	**680**

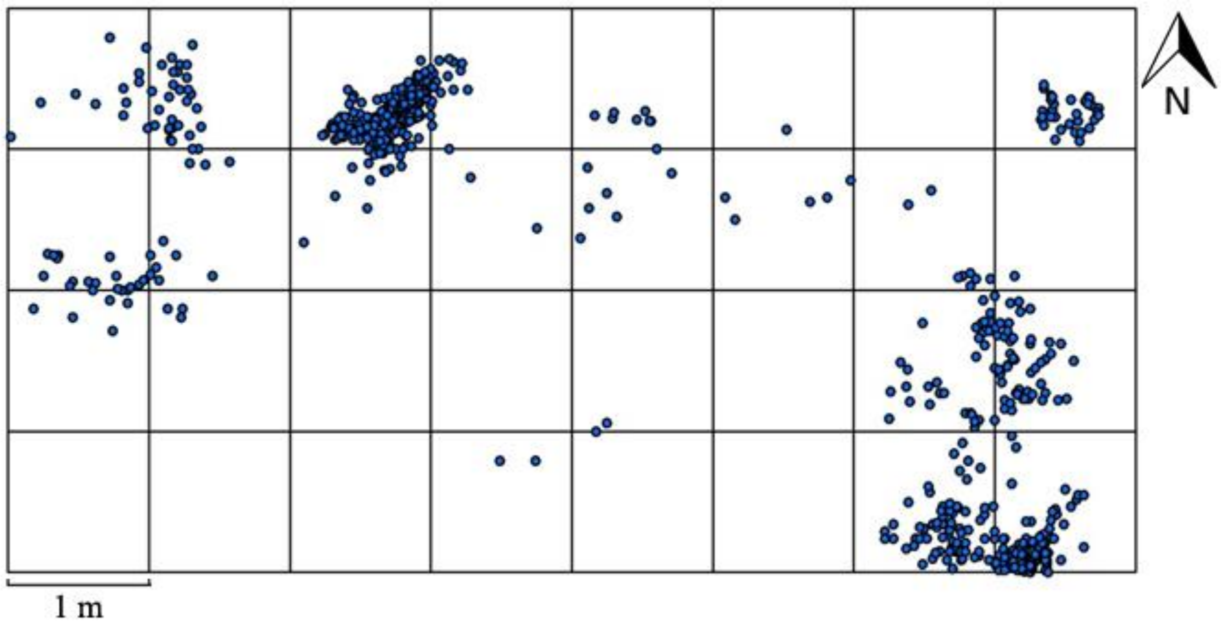


Figure 6.25 Distribution of artifacts from Block C that fell within the clustered dataset according to NN analysis and KDE maps.

6.4.2.4 Block C: K-Means

Once the clustered dataset was determined, the K-means algorithm was applied to the data in order to define cluster memberships. Using the elbow method (Section 5.3.5.4) it was determined that eight clusters were contained within the Block C dataset. Figure 6.26 displays the distribution of artifacts within each cluster.

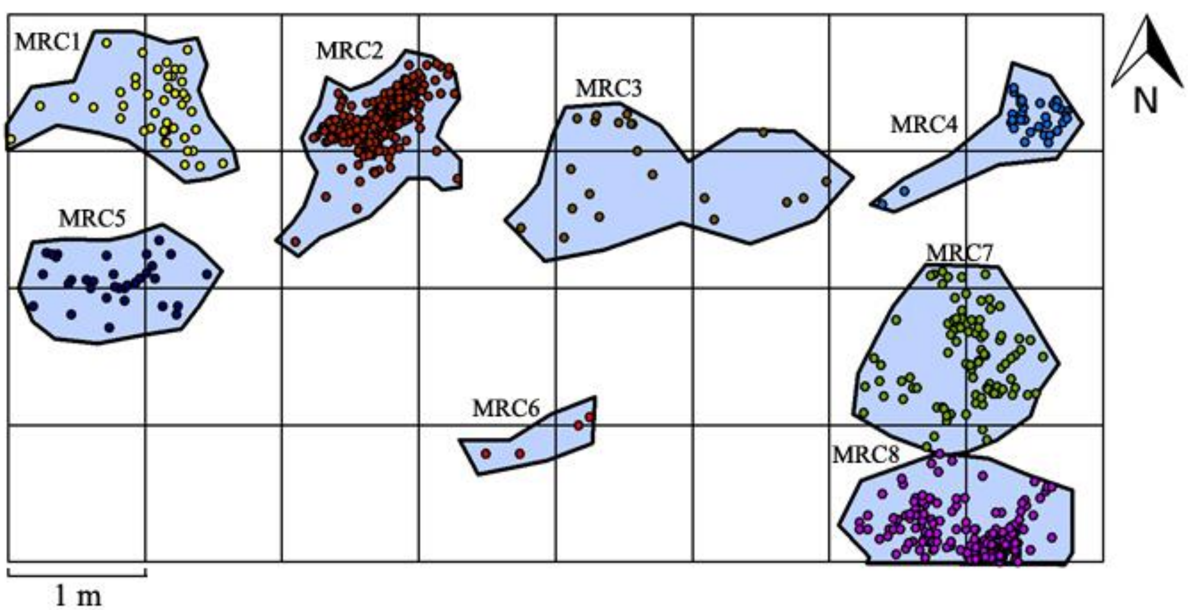


Figure 6.26 Distribution of clusters in Block C as determined through the K-means algorithm.

Cluster MRC1 (Table 6.29) contains a total of 46 artifacts. A variety of raw materials occur in the cluster including quartzite (n=25), BRS (n=2), grey chert (n=5), white chert (n=1), coarse-grained quartzite (n=3), salt and pepper quartzite (n=8), Peace Point Chert (n=1) and heat-altered quartzite (n=1). Debitage includes flake fragments (n=14), bifacial reduction flakes (n=1), block shatter (n=5), decortification flakes (n=16), and re-sharpening flakes (n=1). Tools include a single projectile point, spall tools (n=2), and utilized (n=3) and retouched (n=2) flakes. A single split pebble artifact was also recovered from cluster MRC1. Most of the artifacts in the cluster consist of either small (n=22) or medium (n=22) debitage with a small amount of large debitage present (n=2).

Table 6.29 Artifacts contained in Cluster MRC1.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	25
	BRS	2
	Grey Chert	5
	White Chert	1
	Coarse Grained Quartzite	3
	Salt and Pepper Quartzite	8
	Peace Point Chert	1
	Heat-altered Quartzite	1
	Total	**46**
Artifact Type	Flake Fragment	14
	Bifacial Thinning Flakes	1
	Block Shatter	5
	Decortification Flakes	16
	Edge Modified (Utilized)	3
	Edge Modified (Retouched)	2
	Projectile Point	1
	Re-sharpening Flakes	1
	Cobble / Spall Tool	2
	Split Pebble	1
	Total	**46**
Size Class	Small Debitage (0.66 to 2.5 cm)	22
	Medium Debitage (2.5 to 5 cm)	22
	Large Debitage (Over 5 cm)	2
	Total	**46**

Cluster MRC2 (Table 6.30) consists of 282 artifacts, mostly of quartzite (n=134), and heat-altered quartzite (n=93). Salt and pepper quartzite (n=8) and heat-altered salt and pepper quartzite (n=31) also make up a large percentage of the artifacts in the cluster. Smaller amounts of BRS (n=1), grey chert (n=1), quartz (n=1), coarse grained quartzite (n=1) and Peace Point Chert (n=10) were also found within the cluster. Flake fragments (n=217), bifacial reduction flakes (n=14), block shatter (n=34), decortification flakes (n=11), and a re-sharpening flake (n=1) make up the debitage in the cluster. Endscrapers (n=2), a spall tool (n=1), and bone tools (n=2) also occur in cluster MRC2.

Table 6.30 Artifacts contained in Cluster MRC2 (Note raw material total is without bone tools).

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	134
	BRS	1
	Grey Chert	1
	Quartz	1
	Coarse Grained Quartzite	1
	Salt and Pepper Quartzite	8
	Peace Point Chert	10
	Heat-altered Salt and Pepper Quartzite	31
	Heat-altered Quartzite	93
	Total	**280**
Artifact Type	Flake Fragment	217
	Bifacial Thinning Flakes	14
	Block Shatter	34
	Bone Tools	2
	Decortification Flakes	11
	Endscraper	2
	Resharpening Flakes	1
	Cobble / Spall Tool	1
	Total	**282**
Size Class	Small Debitage (0.66 to 2.5 cm)	249
	Medium Debitage (2.5 to 5 cm)	23
	Large Debitage (over 5 cm)	1
	Unclassified	9
	Total	**282**

Cluster MRC3 (Table 6.31) is made up of 20 artifacts. Artifacts in cluster MRC3 were made of quartzite (n=14) and grey chert (n=6). Debitage includes flake fragments (n=3), a bifacial reduction flake (n=1) and decortification flakes (n=14). A single endscraper, and one split pebble artifact are in the cluster. The cluster is made up of small (n=10) and medium debitage (n=4).

Table 6.31 Artifacts contained in Cluster MRC3.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	14
	Grey Chert	6
	Total	**20**
Artifact Type	Flake Fragment	3
	Bifacial Thinning Flakes	1
	Decortification Flakes	14
	Endscraper	1
	Split Pebble	1
	Total	**20**
Size Class	Small Debitage (0.66 to 2.5 cm)	10
	Medium Debitage (2.5 to 5 cm)	4
	Unclassified	6
	Total	**20**

Cluster MRC4 (Table 6.32) contains 35 artifacts made from quartzite (n=33) and grey chert (n=2). Most of the artifacts consist of debitage including flake fragments (n=26), bifacial reduction flakes (n=3), block shatter (n=2), and decortification flakes (n=3). A single core was also included in the cluster. Small (n=26), medium (n=6), and large (n=1) debitage exist within the cluster.

Table 6.32 Artifacts contained in Cluster MRC4

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	33
	Grey Chert	2
	Total	**35**
Artifact Type	Flake Fragment	26
	Bifacial Thinning Flakes	3
	Block Shatter	2
	Core	1
	Decortification Flakes	3
	Total	**35**

Size Class	Small Debitage (0.66 to 2.5 cm)	26
	Medium Debitage (2.5 to 5 cm)	6
	Large Debitage (over 5 cm)	1
	Unclassified	2
	Total	**35**

Cluster MRC5 (Table 6.33) contains 33 lithic artifacts. A diverse range of raw materials are represented in the cluster including BRS (n=2), Peace Point Chert (n=3), white chert (n=1), grey chert (n=1), heat-altered quartzite (n=3), heat-altered salt and pepper quartzite (n=1) and quartzite (n=22). Artifacts in the cluster include flake fragments (n=14), bifacial reduction flakes (n=1), block shatter (n=2), and decortification flakes (n=9). The tools in the cluster consist of a single endscraper, one spall tool, utilized flakes (n=2) and retouched flakes (n=2). A single core was also located in cluster MRC5. Most of the artifacts within the cluster fall into the medium size class (n=31). A single piece of small debitage and one large piece of debitage are also located within the cluster.

Table 6.33 Artifacts contained in Cluster MRC5.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	22
	BRS	2
	Heat-altered Quartzite	3
	Heat-altered Salt and Pepper Quartzite	1
	Peace Point Chert	3
	White Chert	1
	Grey Chert	1
	Total	**33**
Artifact Type	Flake Fragment	14
	Bifacial Thinning Flakes	1
	Block Shatter	2
	Core	1
	Decortification Flakes	9
	Edge Modified (Utilized)	2
	Edge Modified (Retouched)	2
	Endscraper	1
	Cobble / Spall Tool	1
	Total	**33**
Size Class	Small Debitage (0.66 to 2.5 cm)	1
	Medium Debitage (2.5 cm to 5 cm)	31
	Large Debitage (over 5 cm)	1
	Total	**33**

Cluster MRC6 (Table 6.34) is a small cluster of only four grey chert artifacts. One piece of block shatter, two decortification flakes, and one utilized flake occur within the cluster. Two of the artifacts are of small debitage while two are medium in size.

Table 6.34 Artifacts contained in Cluster MRC6.

Artifact Grouping	Type	Frequency
Raw Material	Grey Chert	4
	Total	**4**
Artifact Type	Block Shatter	1
	Decortification Flakes	2
	Edge Modified (Utilized)	1
	Total	**4**
Size Class	Small Debitage (0.66 to 2.5 cm)	2
	Medium Debitage (2.5 to 5 cm)	2
	Total	**4**

Cluster MRC7 (Table 6.35) is comprised of 91 lithic artifacts. An array of lithic raw materials are represented in the cluster including quartzite (n=12), BRS (n=20), black chert (n=16), argillite (n=11), grey chert (n=3), heat-altered quartzite (n=2), and Peace Point Chert (n=27). The only tool in the cluster is one retouched flake. Debitage includes flake fragments (n=29), bifacial reduction flakes (n=34), a decortification flake (n=1) and re-sharpening flakes (n=26). Artifacts in the cluster are mainly small debitage (n=83), although some micro (n=2), and medium (n=3) artifacts are also present.

Table 6.35 Artifacts contained in Cluster MRC7.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	12
	BRS	20
	Black Chert	16
	Argillite	11
	Grey Chert	3
	Heat-altered Quartzite	2
	Peace Point Chert	27
	Total	**91**
Artifact Type	Flake Fragment	29
	Bifacial Thinning Flakes	34
	Decortification Flakes	1
	Edge Modified (Retouched)	1
	Resharpening Flake	26

	Total	**91**
Size Class	Micro Debitage (0 to 0.66 cm)	2
	Small Debitage (0.66 to 2.5 cm)	83
	Medium Debitage (2.5 to 5 cm)	3
	Unclassified	3
	Total	**91**

A total of 169 artifacts are contained in cluster MRC8 (Table 6.36). These include BRS (n=46), black chert (n=2), Peace Point Chert (n=1), quartzite (n=109), and heat-altered quartzite (n=11). No tools were contained within the cluster, but artifacts include flake fragments (n=93), a bifacial reduction flake (n=1), block shatter (n=20), decortification flakes (n=7), re-sharpening flakes (n=12) and a single split pebble. Most artifacts are small (n=153), although some micro (n=1) and medium (n=13) debitage are included as well.

Table 6.36 Artifacts contained in Cluster MRC8.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	109
	BRS	46
	Black Chert	2
	Heat-altered Quartzite	11
	Peace Point Chert	1
Artifact Type	Flake Fragment	93
	Bifacial Thinning Flakes	1
	Block Shatter	20
	Decortification Flakes	7
	Split Pebble	1
	Resharpening Flake	12
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	153
	Medium Debitage (2.5 to 5 cm)	13
	Unclassified	2

6.4.2.5 Block C: Hot Spot Analysis

The results of the hot spot analysis test are displayed in Figure 6.27. Only two clusters were identified through the hot spot analysis test and no additional clusters were determined. Cluster MRC2 and MRC8 overlap with the clusters defined through the hotspot analysis test.

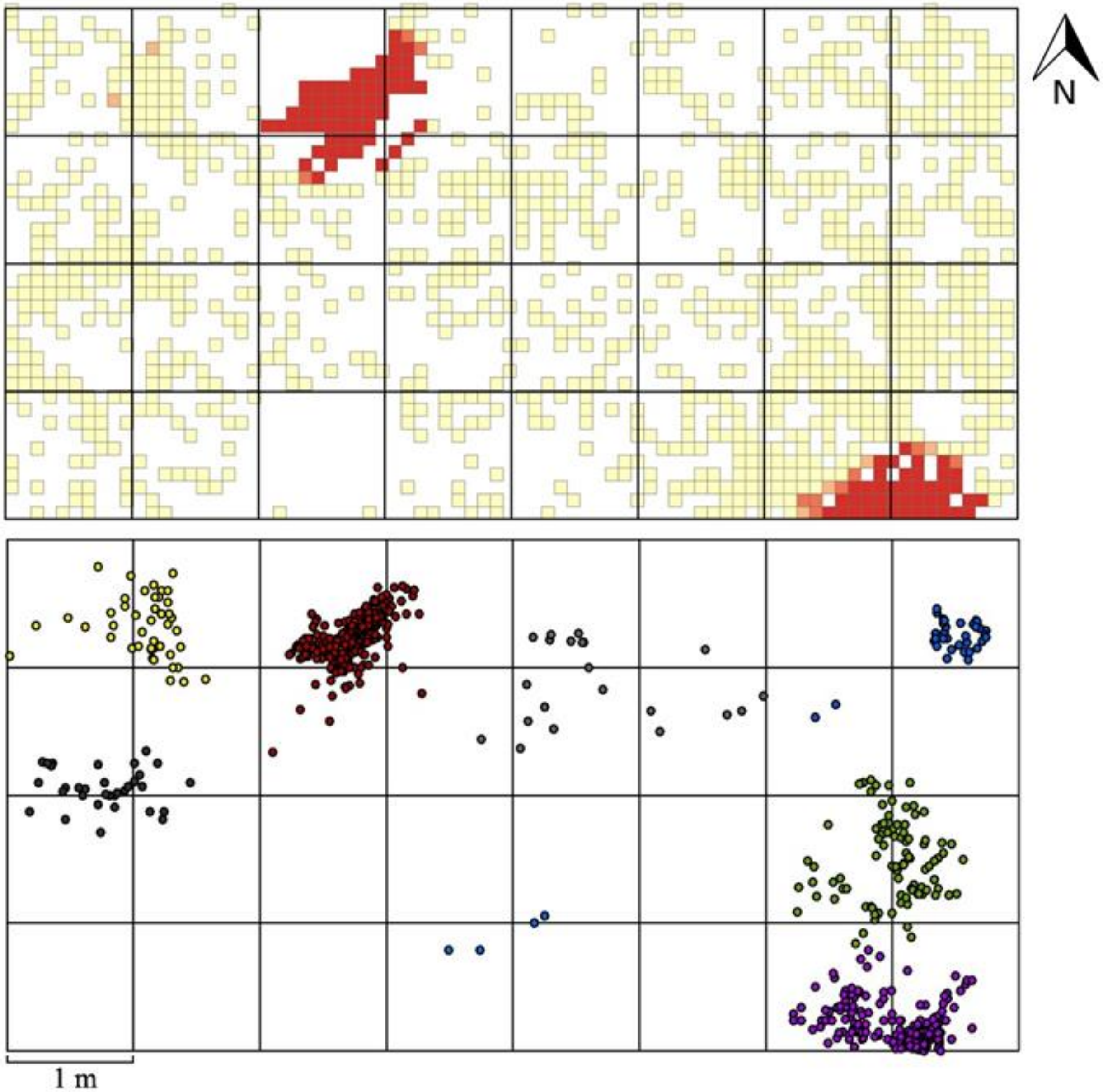


Figure 6.27 Results of the optimized hotspot analysis test (top) compared to the clusters determined through NN analysis, KDE maps, and K-Means (bottom).

6.4.3 Block C: Refits

Only a few refits were discovered in the Block C assemblage (Figure 6.28). One of the refits was two pieces that made up a complete black chert projectile point, while the other refitted artifacts consisted of pairs of flake fragments. All the refits were found close to each other and from similar depths. None of them were from clusters defined by this study.

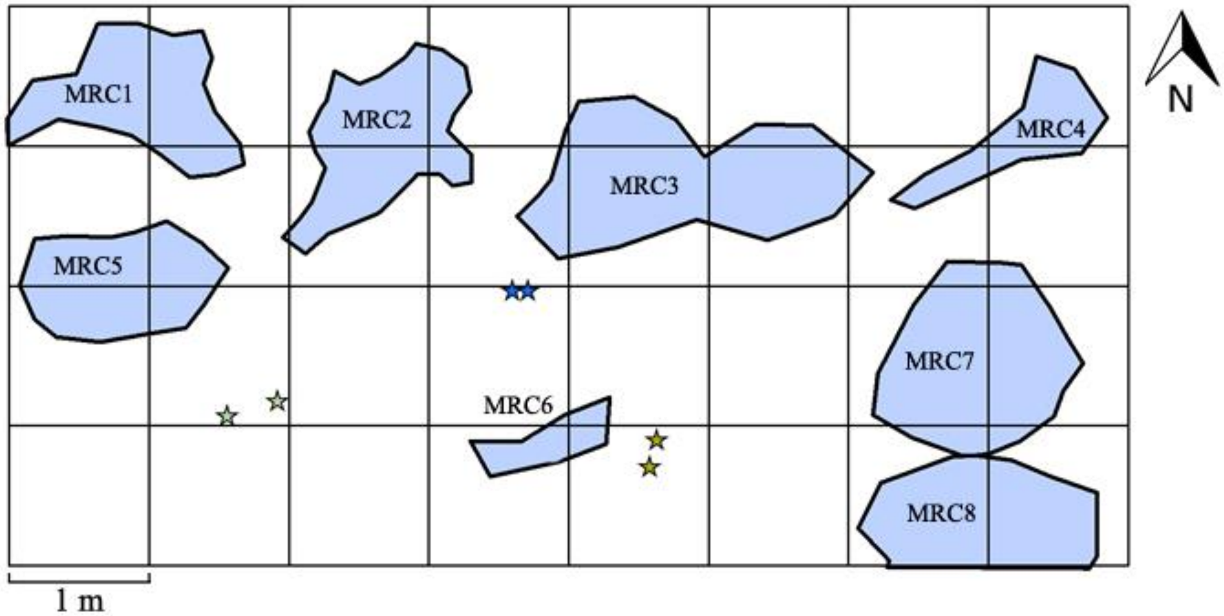


Figure 6.28 Refits recovered from Block C in relation to the defined clusters.

6.5 Block D

Block D is located next to the water's edge (Chapter 3, Figure 3.2). The block is an area of low artifact density with a total of 535 artifacts recovered (Ives 1985:45). Despite the block overall being an area of low artifact density, one unit in Block D contained a high concentration of 345 artifacts. The entire artifact assemblage consists of lithic debitage and tools. Table 6.37 displays all artifacts recovered from Block D according to raw material, artifact type, and size class. Ives (1985:107) defined three clusters in Block D but was uncertain about the temporal relationship between the clusters.

Table 6.37 Artifacts recovered from Block D according to lithic raw material, artifact type, and size class.

Artifact Grouping		Count
Raw Material	Quartzite	331
	Salt and Pepper Quartzite	4
	Heat-altered Quartzite	37
	Heat altered S&P	12
	Coarse Grained Quartzite	4
	BRS	80
	Argillite	11
	Black Chert	30
	Grey Chert	13
	Green Chert	2
	Yellow Chert	2
	White Chert	2
	Peace Point Chert	6
	Quartz	1
	Total	**535**
Artifact Type	Flake Fragment	335
	Block Shatter	38
	Resharpening Flake	4
	Decortification Flake	49
	Bifacial Reduction Flake	4
	Edge Modified (Utilized)	38
	Edge Modified (Retouched)	31
	Split Pebble	7
	Core	1
	Biface	3
	Projectile Point	1
	Endscraper	15
	Uniface	4
	Side Scraper	2
	Spall/Cobble Tool	2
	Wedge	1
	Total	**535**
Size Class	Micro Debitage (0 to 0.66 cm)	1
	Small Debitage (0.66 to 2.5 cm)	179
	Medium Debitage (2.5 to 5 cm)	271
	Large Debitage (over 5 cm)	34
	Unclassified	50
	Total	**535**

6.5.1 Visual Assessment of Block D

A visual assessment of Block D determined that a clear majority of the artifacts were recovered from a dense cluster in the northwest section of the block (Figure 6.29). When grouped by raw material, artifact type, or size class most artifacts that appeared to cluster fell within this larger cluster. An exception to this was heat-altered quartzite artifacts which were found mainly within a smaller cluster to the south (Figure 6.30). Table 6.38 displays which artifacts from Block D were distributed into visible clusters and which ones were not.

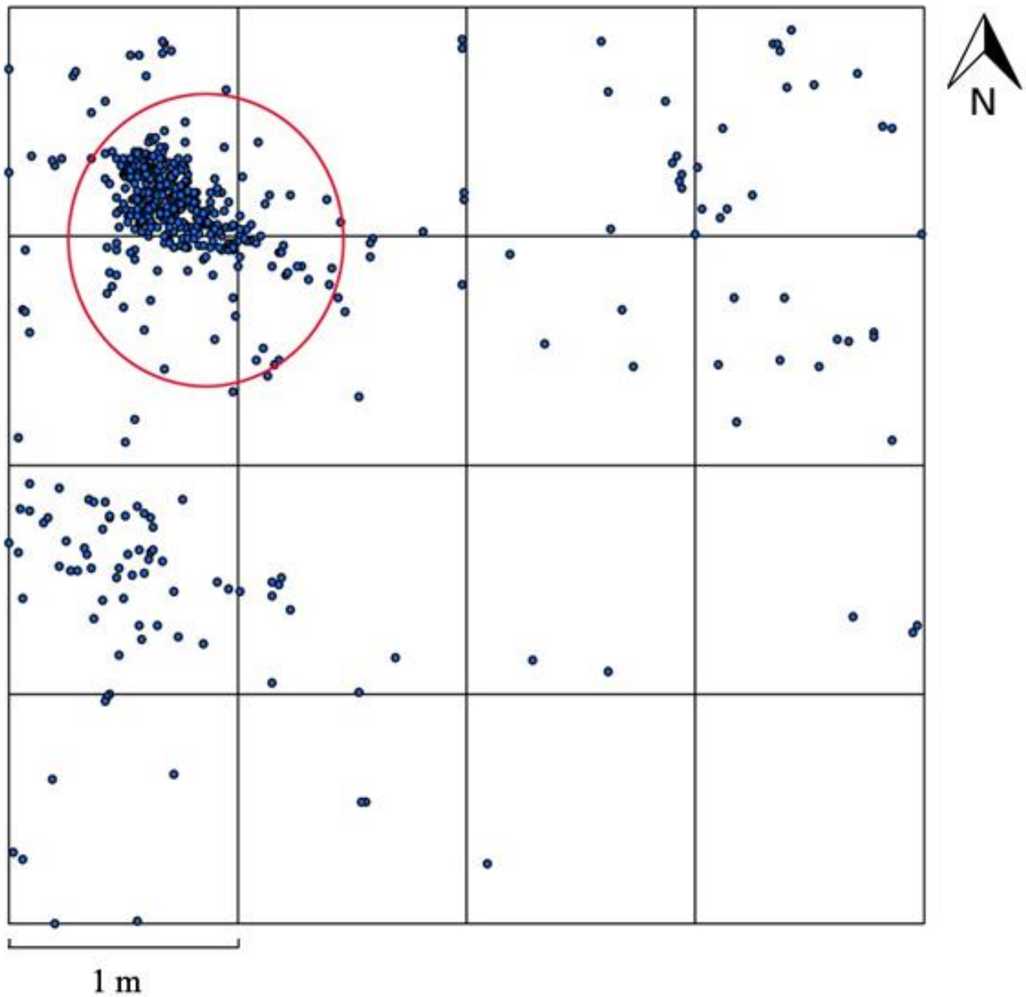


Figure 6.29 A large cluster of artifacts observed in the northwest section of Block D (red circle).

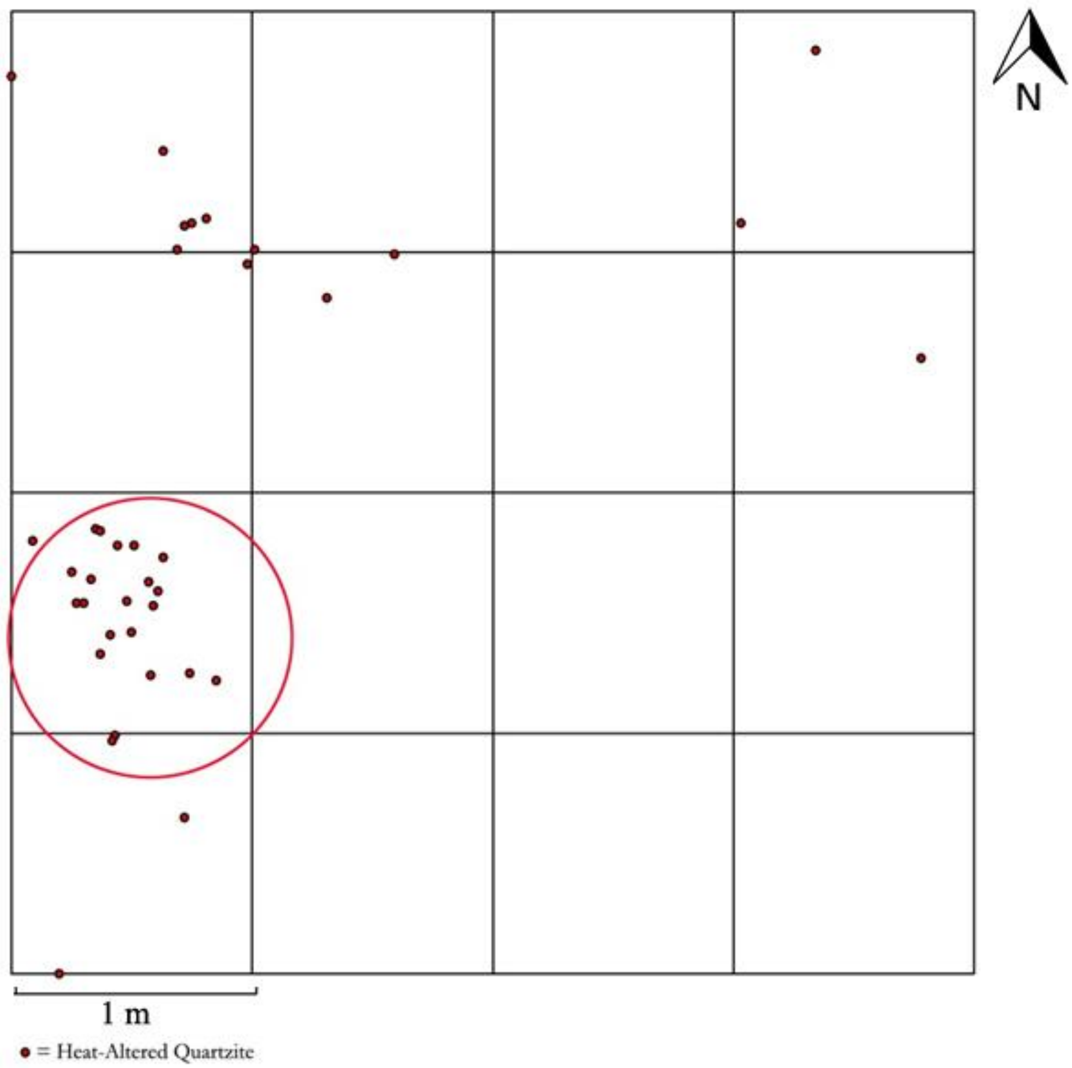


Figure 6.30 A cluster of heat-altered quartzite identified in Block D (red circle).

In terms of the vertical distribution of artifacts one irregularity was observed with the depth values of artifacts in the dense cluster observed in the north end of the block. Within the cluster there was a gap of 5 cm in which no artifacts were recorded (Figure 6.31). During excavation, the artifacts tended to be lying against each other, or with very little sediment in between them (Ives personal communication 2015). There were also three separate periods of excavation; August and early September of 1976, followed by additional work in 1980. It is possible that the depths of some of the artifacts were incorrectly recorded or were recorded using a different datum. Since the irregularity was exactly 5 cm, to correct this 5 cm were subtracted from the underlying values to eliminate the gap. Other than this, no vertical patterning was noticed in the distribution of artifacts.

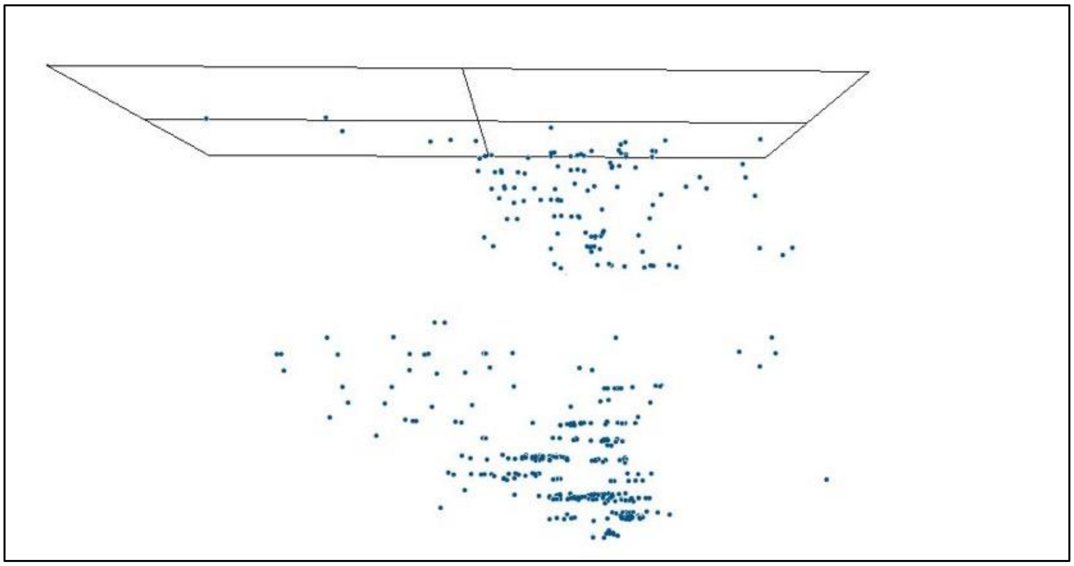


Figure 6.31 A gap of 5 cm was noted in the depth values of a dense cluster of artifacts observed in the north end of Block D.

Table 6.38 Artifact groups that appeared to be horizontal clustered based solely on visual analysis of the artifact groupings.

Artifact Grouping	Patterns Observed	No Patterns Observed
Raw Material	Argillite	Green Chert
	Black Chert	Yellow Chert
	Beaver River Sandstone	Salt and Pepper Quartzite
	Grey Chert	Quartz
	Peace Point Chert	White Chert
	Quartzite	
	Coarse Grained Quartzite	
	Heat-altered S&P Quartzite	
	Heat-altered Quartzite	
Artifact Type	Flake Fragment	Bifacial Reduction Flake
	Block Shatter	Resharpening Flake
	Decortification Flake	Core
	Split Pebble	Biface
	Endscraper	Cobble / Spall Tool
	Edge Modified (Utilized)	Wedge

	Edge Modified (Retouched)	Projectile Point
	Uniface	Side Scraper
Size Class	Small Debitage (0.66 to 2.5 cm)	Micro Debitage (0 to 0.66 cm)
	Medium Debitage (2.5 to 5 cm)	
	Large Debitage (over 5 cm)	

6.5.2 Statistical Analysis of Block D

A visual inspection of the distribution of materials in Block D determined that most artifacts appeared to cluster. A statistical analysis of Block D set out to determine if the observed clusters were supported and to see if any clusters exist within the data that were missed through visual inspection.

6.5.2.1 Block D: Surface Interpolation

A surface interpolation test was conducted for each artifact category in Block D containing more than one artifact. Consequently, no test was conducted for cores, wedges, microdebitage or artifacts made of quartz. The results of the surface interpolation test determined that artifacts in Block D were vertically scattered with little to no pattern in their vertical provenience. All artifact classes from Block D were found anywhere between 5 to 30 cmbd.

6.5.2.2 Block D: Nearest Neighbour Analysis

A NN test was conducted for each artifact category in Block D that contained more than one artifact. The NN test confirmed the presence of several clusters in the Block D data (Table 6.39). Clusters identified by the NN test were the same as those determined through visual analysis. According to the NN test only 4 of the 13 different raw material types tested were distributed randomly across the block. Five of 12 artifact types were distributed randomly, and none of the artifacts were distributed randomly based on size class.

Table 6.39 Results of the NN test for Block D based on each artifact raw material, artifact type, and size class.

Artifact Grouping	Clustered	Random
Raw Material	Argillite	Green Chert
	Beaver River Sandstone	Yellow Chert
	Black Chert	White Chert
	Grey Chert	Salt and Pepper Quartzite
	Peace Point Chert	
	Quartzite	
	Heat-altered Quartzite	
	Heat-altered S&P Quartzite	
	Coarse Grained Quartzite	
Artifact Type	Flake Fragment	Bifacial Reduction Flake
	Block Shatter	Resharpening Flake
	Decortification Flake	Biface
	Split Pebble	Cobble/Spall Tool
	Edge Modified (Utilized)	Side Scraper
	Edge Modified (Retouched)	
	Uniface	
Size Class	Small Debitage (0.66 to 2.5 cm)	
	Medium Debitage (2.5 to 5 cm)	
	Large Debitage (over 5 cm)	

6.5.2.3 Block D: Kernel Density Estimation

The NN test determined that many of the artifacts recovered from Block D were statistically clustered. KDE maps were created for each clustered artifact group to determine where the clusters are located. Figure 6.32 shows an example of a KDE map created for black chert artifacts. All the artifacts that fell within the designated hotspots in the KDE maps were isolated and placed into a single shape file. Of the 575 artifacts recovered from Block D 316 were included in the clustered dataset. Table 6.40 displays which artifacts were included in the clustered dataset and Figure 6.33 shows how they were distributed throughout the block.

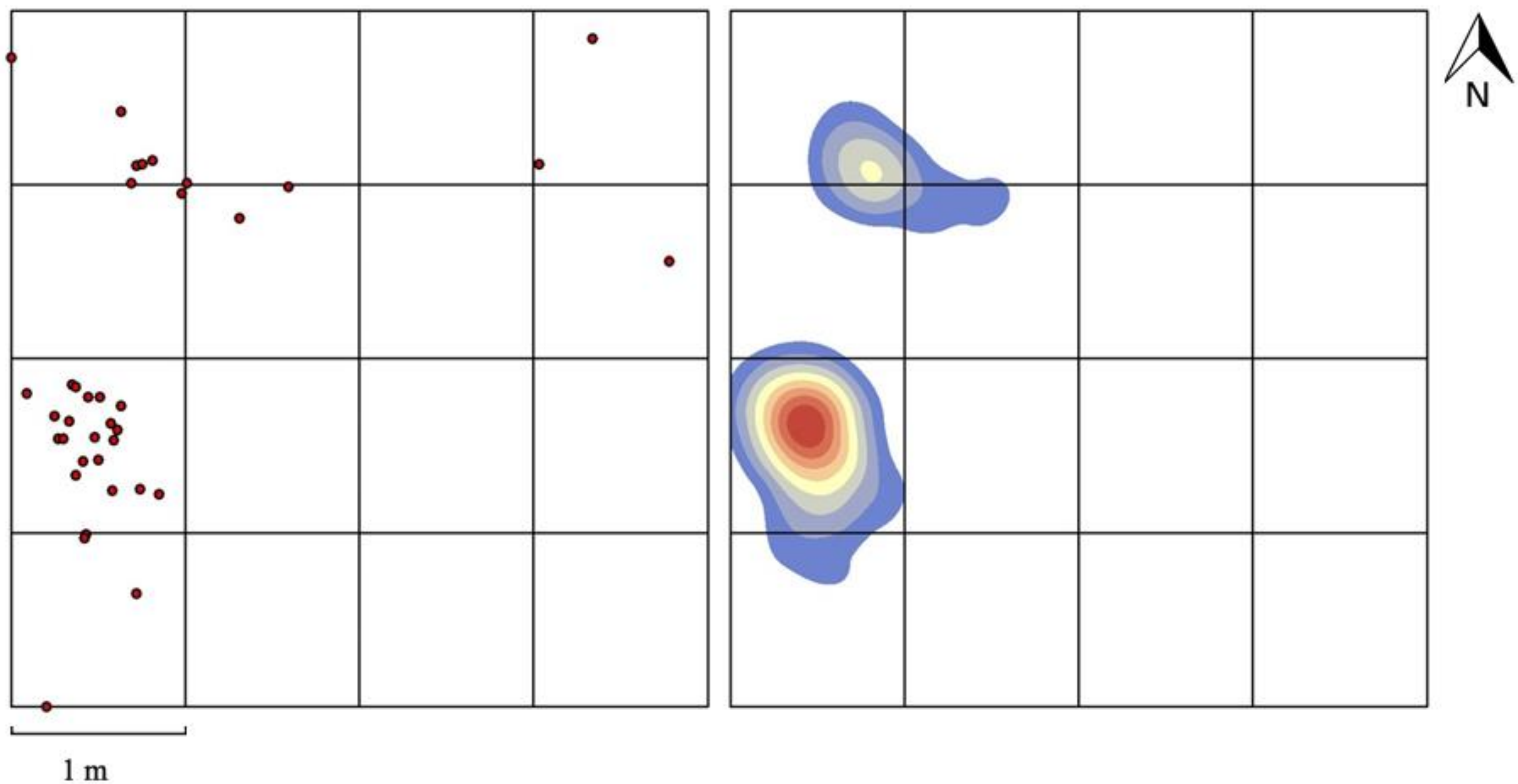


Figure 6.32 KDE map created for heat-altered quartzite artifacts recovered from Block D.

Table 6.40 Artifacts from Block D that were included in the clustered dataset, grouped by raw material, artifact type, and size class.

Artifact Grouping	Type	Frequency
Raw Material	Argillite	8
	Black Chert	19
	Beaver River Sandstone	61
	Coarse Grained Quartzite	4
	Grey Chert	5
	Green Chert	2
	Yellow Chert	2
	White Chert	1
	Peace Point Chert	6
	Quartzite	173
	Heat-altered Quartzite	24
	Salt and Pepper Quartzite	1
	Heat-altered S&P Quartzite	10
	Total	**316**
Artifact Type	Flake Fragment	193
	Block Shatter	22
	Decortification Flake	34
	Edge Modified (Utilized)	29
	Edge Modified (Retouched)	14
	Endscrapers	10
	Split Pebble	6
	Spall/Cobble Tool	2
	Biface	2
	Uniface	4
	Total	**316**
Size Class	Small Debitage (0.66 to 2.5 cm)	78
	Medium Debitage (2.5 to 5 cm)	196
	Large Debitage (over 5 cm)	15
	Unclassified	27
	Total	**316**

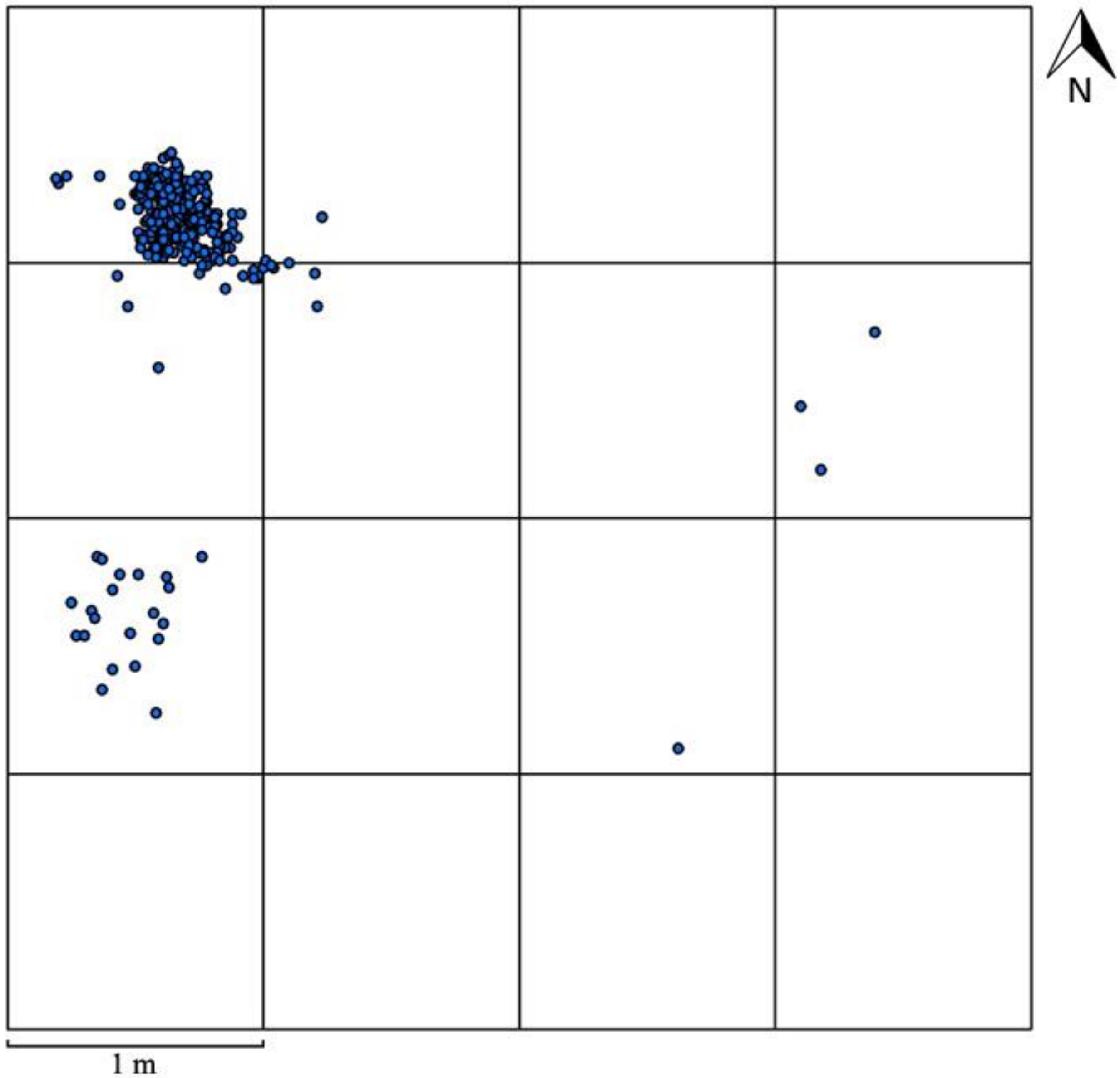


Figure 6.33 Distribution of artifacts from Block D that fell within the clustered dataset according to NN analysis and KDE maps.

6.5.2.4 Block D: K-Means

Once the clustered dataset was determined the K-means algorithm was applied to the Block D data to determine which artifacts belonged in which cluster. Using the elbow method (Section 5.3.5.4) it was determined that three clusters exist within the Block D assemblage. Figure 6.34 displays the distribution of artifacts within each cluster. Each cluster was labelled consecutively from MRD1 to MRD3.

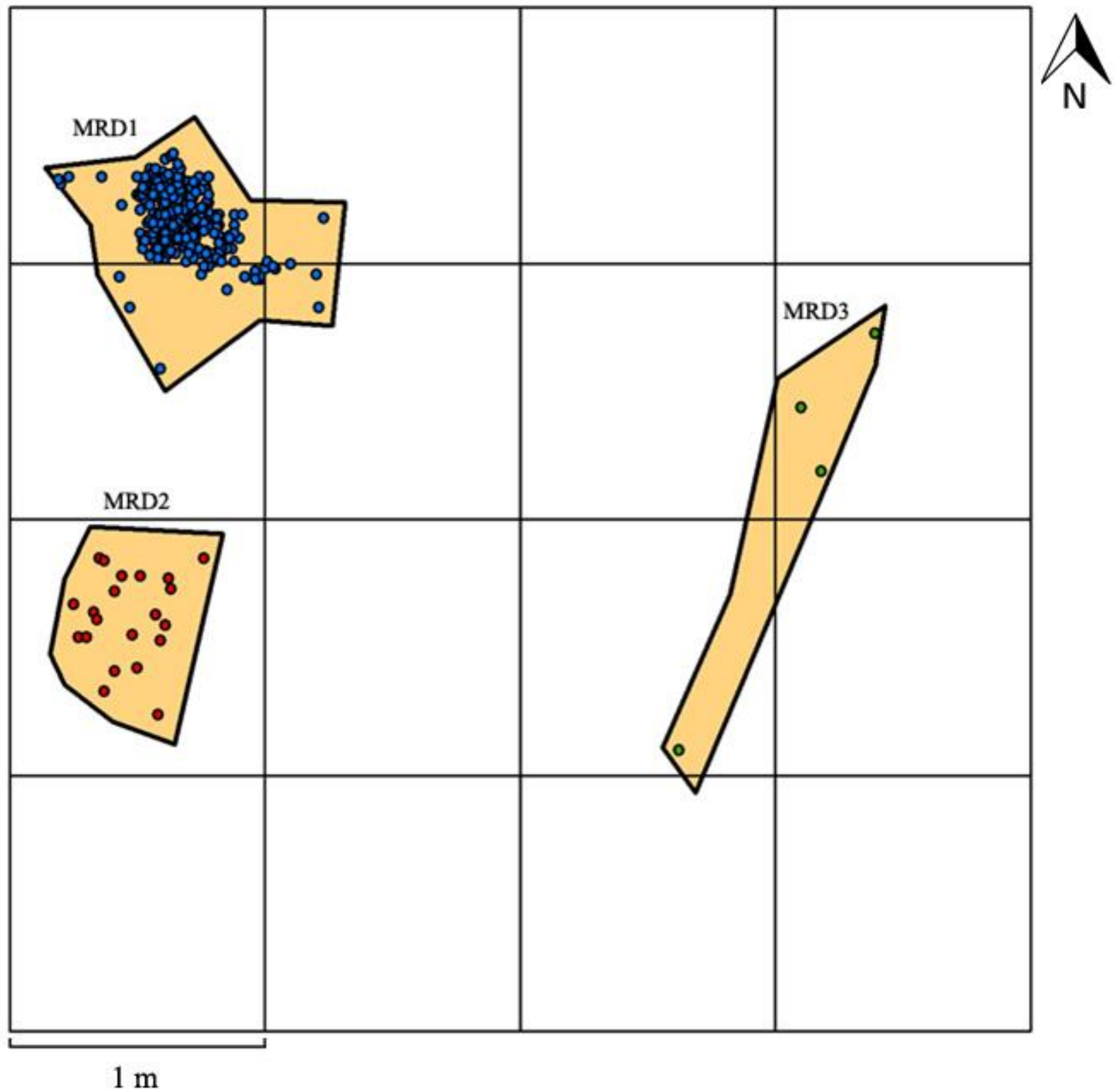


Figure 6.34 Distribution of clusters in Block D as determined through the K-means algorithm.

Cluster MRD1 (Table 6.41) was the largest cluster in the Block D assemblage with a total of 291 artifacts. A diverse array of raw materials are represented in the cluster including quartzite (n=173), BRS (n=61), black chert (n=19), argillite (n=8), grey chert (n=5), yellow chert (n=2), green chert (n=1), white chert (n=1), Peace Point Chert (n=6), salt and pepper quartzite (n=1), heat-altered quartzite (n=7), and heat-altered salt and pepper quartzite (n=6). Debitage includes flake fragments (n=163), block shatter (n=21), and decortification flakes (n=33). An unusually high number of tools were found within the MRD1 cluster, including bifaces (n=3), utilized flakes (n=29), retouched flakes (n=22), endscrapers (n=3), unifaces (n=3) and side scrapers (n=2). Six split pebble artifacts are also contained within cluster MRD1. Artifacts in the small (n=78), medium (n=196) and large (n=17) size categories are represented within the cluster.

Table 6.41 Artifacts contained within Cluster MRD1.

Artifact Grouping	Type	Frequency
Raw Material	Quartzite	173
	BRS	61
	Black Chert	19
	Argillite	8
	Grey Chert	5
	Yellow Chert	2
	Green Chert	2
	White Chert	1
	Salt and Pepper Quartzite	1
	Heat-altered Quartzite	7
	Heat-altered Salt and Pepper Quartzite	6
	Peace Point Chert	6
	Total	**291**
Artifact Type	Flake Fragment	163
	Biface	3
	Block Shatter	21
	Decortification Flakes	33
	Edge Modified (Utilized)	29
	Edge Modified (Retouched)	22
	Endscraper	9
	Uniface	3
	Side Scraper	2
	Split Pebble	6
	Total	**291**
Size Class	Small Debitage (0.66 to 2.5 cm)	78
	Medium Debitage (2.5 to 5 cm)	196
	Large Debitage (Over 5 cm)	17
	Total	**297**

A total of 21 artifacts is contained in cluster MRD2 (Table 6.42), consisting of heat-altered quartzite (n=17) or heat-altered salt and pepper quartzite (n=4). No tools are contained in the cluster which is comprised of flake fragments (n=20) and a single decortification flake. All the artifacts in cluster MRD2 are classified in the small size class.

Table 6.42 Artifacts contained in Cluster MRD2

Artifact Grouping	Type	Frequency
Raw Material	Heat-altered Quartzite	17
	Heat-altered Salt and Pepper Quartzite	4
	Total	**21**

Artifact Type	Flake Fragment	20
	Decortification Flakes	1
	Total	**21**
Size Class	Small Debitage (0.66 to 2.5 cm)	21
	Total	**21**

Cluster MRD3 (Table 6.43) is a small cluster of four artifacts. All the artifacts in the cluster are coarse-grained quartzite. Flake fragments (n=1), block shatter (n=1) and cobble tools (n=2) are contained in the cluster. Unfortunately, none of the artifacts from Cluster MRD2 were available to be measured.

Table 6.43 Artifacts contained in Cluster MRD3.

Artifact Grouping	Type	Frequency
Raw Material	Coarse Grained Quartzite	4
	Total	4
Artifact Type	Flake Fragment	1
	Block Shatter	1
	Cobble / Spall Tool	2
	Total	4
Size Class	Unclassified	4
	Total	4

6.5.2.5 Block D: Hot Spot Analysis

The results of the hot spot analysis test for Block D are shown in Figure 6.35. Only one cluster was identified through the hot spot analysis test. No additional clusters were found; however, cluster MRD1 lined up with the cluster determined through the hotspot test.

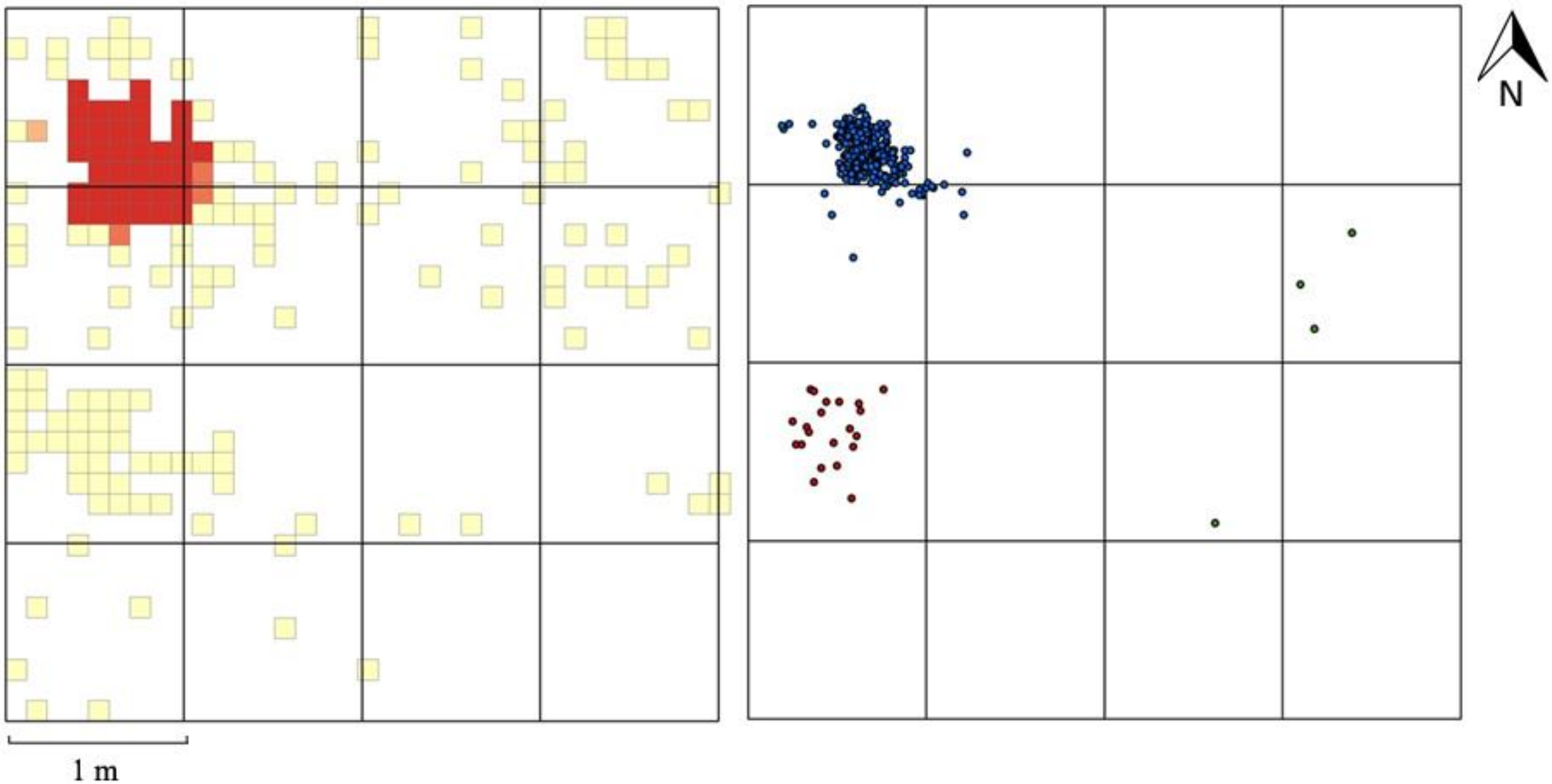


Figure 6.35 Results of the optimized hotspot analysis test (left) compared to the clusters determined through NN analysis, KDE maps, and K-Means.

6.5.3 Block D: Refits

Only one refit was found in the Block D assemblage. A single flake fragment was found that reattached to a retouched flake. The refits were found close together and from a similar depth with only 1 cm difference in their vertical distribution. The refitting artifacts were both from cluster MRD1 (Figure 6.36).

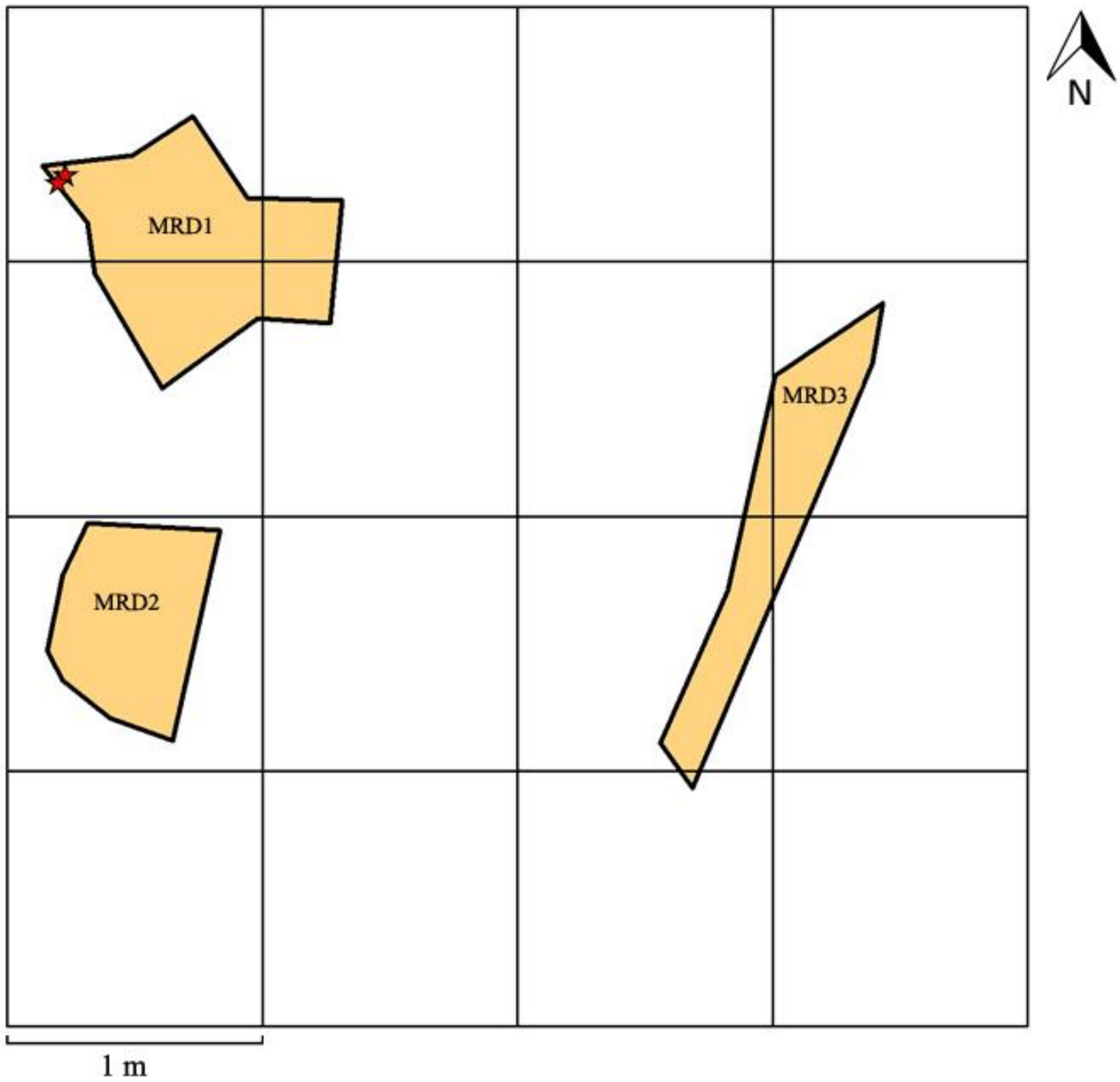


Figure 6.36 Location of refits in Block D in relation to the defined clusters.

6.6 Conclusion

The methods chosen for this study allowed for the identification of nine clusters in Block A, five clusters in Block B, eight clusters in Block C, and three clusters in Block D. This study could not have been completed without the use of data collected using three-point provenience measurements. Interpretations of each cluster will be presented in Chapter 7, along with a critical analysis of the methods employed for this study. Each cluster will be assessed based on the artifacts within it, and the potential for cluster overlap or mixing will also be considered.

CHAPTER 7: INTERPRETATIONS

7.1 Introduction

Spatial analysis of the Eaglenest Portage site facilitated the interpretation of activity areas and spatial organization of each of the four excavated blocks. While factors such as the lack of sediment deposition, the scarcity of organic remains, and the potential for bioturbation hinder the interpretation of the archaeological record in the region, a focus on spatial clusters identified through spatial analysis of artifacts mapped in situ improves the interpretability of the Eaglenest Portage assemblage.

7.2 2014 Fieldwork

Although the 2014 fieldwork produced too few artifacts for a comparative spatial analysis to be made with the materials recovered in 1976, it did offer the opportunity to contextualize those original data. Evidence of disturbance was observed in both the shovel tests and the 1.5 m^2 test excavation. Mottling of soil horizons observed in some of the shovel tests may be indicative of disturbance caused when dead or dying trees fall and pull up their root systems. Animal burrowing was noted in the form of a large squirrel nest (see Chapter 5, Figure 5.1).and through the presence of infilled holes documented during excavation. Root disturbance was observed throughout the site, as would be expected of most sites in a forested environment. Some artifacts were also exposed through erosion of the terrace bank adjacent to where Block A was located.

A buried Ae horizon was documented in both the test excavation as well as in one of the shovel tests (Chapter 2, Section 2.5, Figure 2.6). Ives (1985:32) noted a linear buried Ae horizon with a rosy hue in Block C, which he suggested could represent either an isolated segment of a living floor or the result of a forest fire with subsequent deposition of sand filling a microtopographic depression. The buried Ae horizon noted during the 2014 fieldwork contained a light gray silty sand and was documented close to where Block B was located. The buried Ae horizon only appeared intermittently at the site, as evidenced by the fact that it was only observed in the test excavation and one shovel test.

As Ives pointed out, the buried Ae horizon could be explained by both cultural and natural phenomenon. James Ahnassay, a former chief of the Dene Tha', has described the use of linear shaped hearths: “We had long hearths outside the tents in the past for a simple reason- people could not chop large branches or trunks, so they burnt large pieces" (Gregory Kwiecien personal communication 2015). A similar feature used in the past could be preserved in the archaeological record and leave a linear stain in the soil profile which appears as a buried soil horizon with a rosy hue. Evidence for such a feature might co-occur with a high density of heat-altered artifacts. Only a handful of artifacts were recovered from the excavated test pit near Block B and none of them showed evidence for heat-alteration.

As Ives pointed out, a forest fire with subsequent sand filling microtopographic depressions could also account for the buried soil horizons. Schaetzl (1986) hypothesized the potential for soil horizons to become inverted when an uprooted tree is rapidly burned by fire. The fire would need to rapidly consume most of the trunk before the collapse of the root plate onto the ground surface which would cause profile inversion. A scenario such as this could explain intermittent buried A horizons at the Eaglenest Portage site, whether the soil horizons are inverted or not. Whether those fires could have been caused by human or natural causes is beyond the scope of this study.

Although only a few artifacts were recovered from the 2014 excavation, they were found both above and below the buried Ae horizon with no clear indications that any specific artifact type was associated specifically with that horizon. However, evidence of rodent burrowing was observed during excavation and such burrowing could have resulted in artifact mixing. The 2014 fieldwork confirmed that artifact mixing may have occurred throughout the site, and it is important to keep that in mind as cluster overlap or cluster mixing is a strong possibility. Incidences where cluster overlap or mixing may have occurred will be noted in the interpretation of each cluster.

7.3 Cluster Interpretation

Cluster interpretation at the Eaglenest Portage site is significantly hindered by the fact that the vast majority of the assemblage consists of lithic materials. While stone tool production and use were an important aspect of everyday life for the people who inhabited the site, it still only accounts for a portion of the day-to-day activities. Regardless, stone tools and debitage offer great interpretive value. Numerous end- and sidescrapers were present at the site, and microscopic edge analysis confirms that some specimens were used to work hides, others were used to work bone or wood, while some may have been unused (Ives 1977:28). Activity areas can be identified where lithic reduction, tool creation, food processing, cooking, and hide working occurred. Furthermore, the distribution of heat-altered materials and what little bone was recovered can be used to help infer the presence of features like hearths that otherwise could not be identified in the field (Chapter 5, Section 5.3.6.1). Artifacts contained in the identified clusters were analysed and grouped or compared with the following categories in mind:

- Lithic reduction: The process by which cores are reduced to create formal tools (Gibson 1998). Hammerstones, cores, and decortification flakes are characteristic of clusters in this category.
- Lithic working: The process of retouching, or placing the final touches on a finished tool. This process usually results in higher amounts of micro debitage and may be associated with broken or incomplete tools (Gibson 1998).
- Hide preparation or hide working: Hide preparation is the process of "scraping, rubbing, smoking, and curing" of animal hides for domestic use (Gibson 1998:77). Hide working is the creation and maintenance of clothing, tent covers, and other materials from prepared hides. Artifacts used for scraping such as endscrapers, knives or expedient tools will be characteristic of a cluster in this category. It should be noted that although endscrapers are often associated with hide work, they can serve a variety of scraping utilities including planing wood or bone, or they may be used as a multi-purpose tool (Kyle Belanger personal communication 2017). In the same manner, expedient tools such as retouched or utilized flakes could be used for a variety of activities that may generally not be evident in the archaeological record such as basketry or medicine preparation (Roskowski 2015:95). Unfortunately, spatial analysis is unlikely to allow differentiation between hide working and wood working or other activities; however, usewear and residue studies in conjunction with spatial analysis could aid in such interpretations.
- Food preparation: A variety of tools may be associated with food preparation, many of which are often expedient (Odell 2004:81). Food preparation would often (but not always) take place near a hearth, and waste may be deposited in the hearth or away from the hearth in a toss zone (Binford 1983, Stevenson 1985, Gibson 1998). Although bone is limited in the Eaglenest Portage assemblage, any clusters found in close proximity to bone or dense amounts of heat-altered materials strengthen the interpretation of clusters that may fall into this category.

- Refuse pile: A refuse pile refers to a cluster that represents artifacts that were collected and dumped, and is usually found on the periphery of a site (Gibson 1998). Refuse piles will often have a heterogeneous combination of debitage and exhausted or broken tools representing a range of functions (Bamforth et al. 2005; Keeley 1991). In a site with multiple occupations a refuse pile can easily be mistaken for an area where significant cluster overlap may have occurred. A refuse pile may also occur as the result of waste deposited away from a hearth in a toss zone.

It is important to note that although each cluster identified in the Eaglenest Portage assemblage may fall into one of the above categories, cluster interpretation is not always so straight forward. Some clusters may not provide enough information to solidly place them in each of the above categories. In instances where multiple explanations for clusters are possible this is noted.

An effort was made to interpret clusters in relation to the artifacts contained within them; however, the distribution of artifacts surrounding a cluster was also taken into consideration. This is in acknowledgement of the fact that some artifacts associated with a specific cluster may not always be identified through spatial statistics. For instance, a single sandstone hammerstone found in relation to a cluster containing mostly quartzite decortification flakes and cores may be associated with that cluster, but may not have been included in the cluster since statistically the raw material and artifact type of the hammerstone make it an outlier. In the same vein, artifacts surrounding any potential invisible or phantom hearth features (Chapter 5, Section 5.3.6.1) were also considered, even if they were not contained directly within the defined cluster. This allowed for the assessment of potential toss zones. Any instances where artifacts not contained within the originally defined cluster, but which aided in the interpretation of the cluster, was done so cautiously and will be clearly noted.

7.4 Block A

A total of nine horizontal spatial clusters were identified in the Block A assemblage. Ives (1985:164) identified two spatial clusters in the block and suggested that cluster overlap was likely to have occurred. The block is characterized by high artifact densities with a diverse range of lithic raw materials and artifact types.

7.4.1 Cluster MRA1

Cluster MRA1 consists entirely of Beaver River Sandstone (BRS) materials, and is mostly made up of micro debitage. No tools are contained within the cluster, and very few tools were found surrounding the cluster. The one exception is a single quartzite utilized flake which was recovered near the cluster, but was not statistically included in the cluster composition. Given that cluster MRA1 consists entirely of one raw material type with all items being of similar size, evidence for cluster overlap or mixing is considered weak. The large quantity of micro debitage in the cluster indicates that this cluster represents an area where lithic working or stone tool finishing took place. The lack of tools or larger debitage can be explained by the fact that these items are more likely to be curated or discarded elsewhere, respectively, whereas small items such as micro debitage may be left behind and trampled into the sediment (Keeley 1991).

7.4.2 Cluster MRA2

Cluster MRA2 coincides with the approximate location of where Ives identified one of two clusters in Block A, cluster A1 (Ives 1985:164). However, the composition of the cluster is significantly different than the one defined by Ives. In total, Ives' cluster A1 contained five utilized flakes and one split pebble artifact (Ives 1985:84). In contrast, cluster MRA2 contained mainly lithic debitage, one split pebble artifact, and only one utilized flake (Chapter 6, Section 6.2.2.4; Table 6.7). All the artifacts in cluster MRA2 were made of green and grey chert. Figure 7.1 shows the distribution of utilized flakes in Block A in relation to cluster MRA2. Clearly, there are a large number of utilized flakes located near and even overlapping with cluster MRA2. However, the nearest neighbour test determined that the distribution of utilized flakes in Block A is random (Figure 7.2; Chapter 6, Section 6.2.2.2).

The utilized flakes located near, but not included in cluster MRA2, were fashioned out of quartzite and black chert. Interestingly, green chert artifacts were one of the few artifact types from Block A that were vertically distributed in a patterned fashion, with no green chert artifacts recovered below 19 centimeters below datum (cmbd) (Chapter 6, Section 6.2.2.1). However, grey chert artifacts were randomly distributed vertically throughout the block. Despite this, all the grey chert artifacts contained in cluster MRA2 were recorded only to a maximum depth of 18 cmbd. In contrast, the black chert and quartzite utilized flakes were recovered from varying depths, with most recorded below 20 cm. Assuming the green and grey chert artifacts were deposited more recently than most other artifacts from the block, there may have been less of a chance for them to become more broadly vertically scattered by bioturbation. Since the utilized flakes in Ives' cluster A1 are of a different raw material type and were recorded from depths inconsistent with that of the rest of the artifacts in cluster MRA2, it is assumed that they are probably unrelated. However, if the cluster defined by Ives is valid, then the assumption can be made that cluster overlap occurred here with cluster MRA2 and cluster A1 defined by Ives.

The presence of decortification flakes, flake fragments, and shatter in cluster MRA2 are evidence of lithic reduction. The split pebble artifact may indicate that local materials were used, as plenty of small chert pebbles were observed in the stream adjacent to Block A. The utilized flake could have been used for multiple purposes including sawing, cutting, and scraping of wood, bone or hides. The re-sharpening flakes could be evidence of the final retouch of a finished tool that was carried away later.

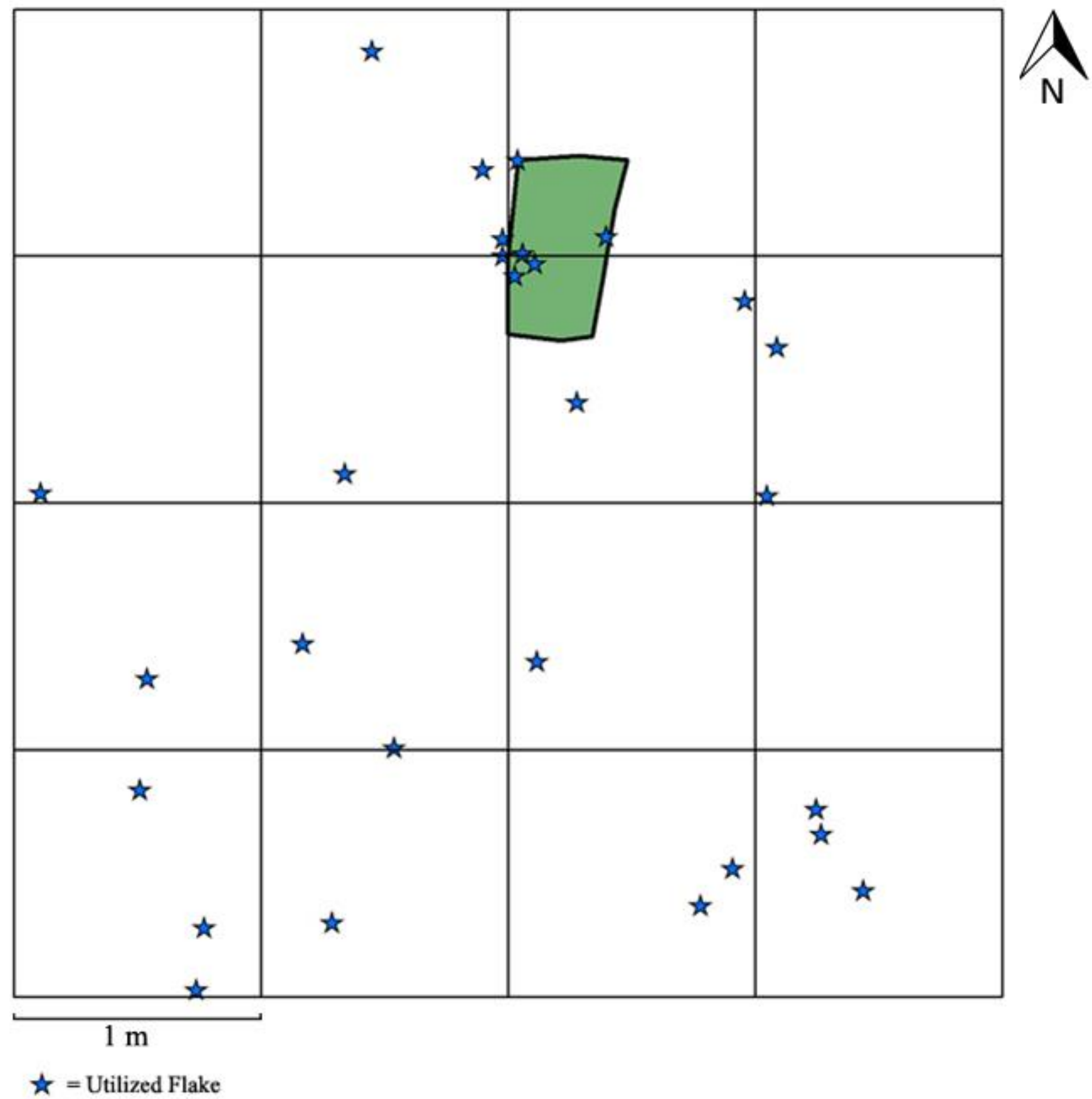


Figure 7.1 Distribution of utilized flakes in relation to cluster MRA2.

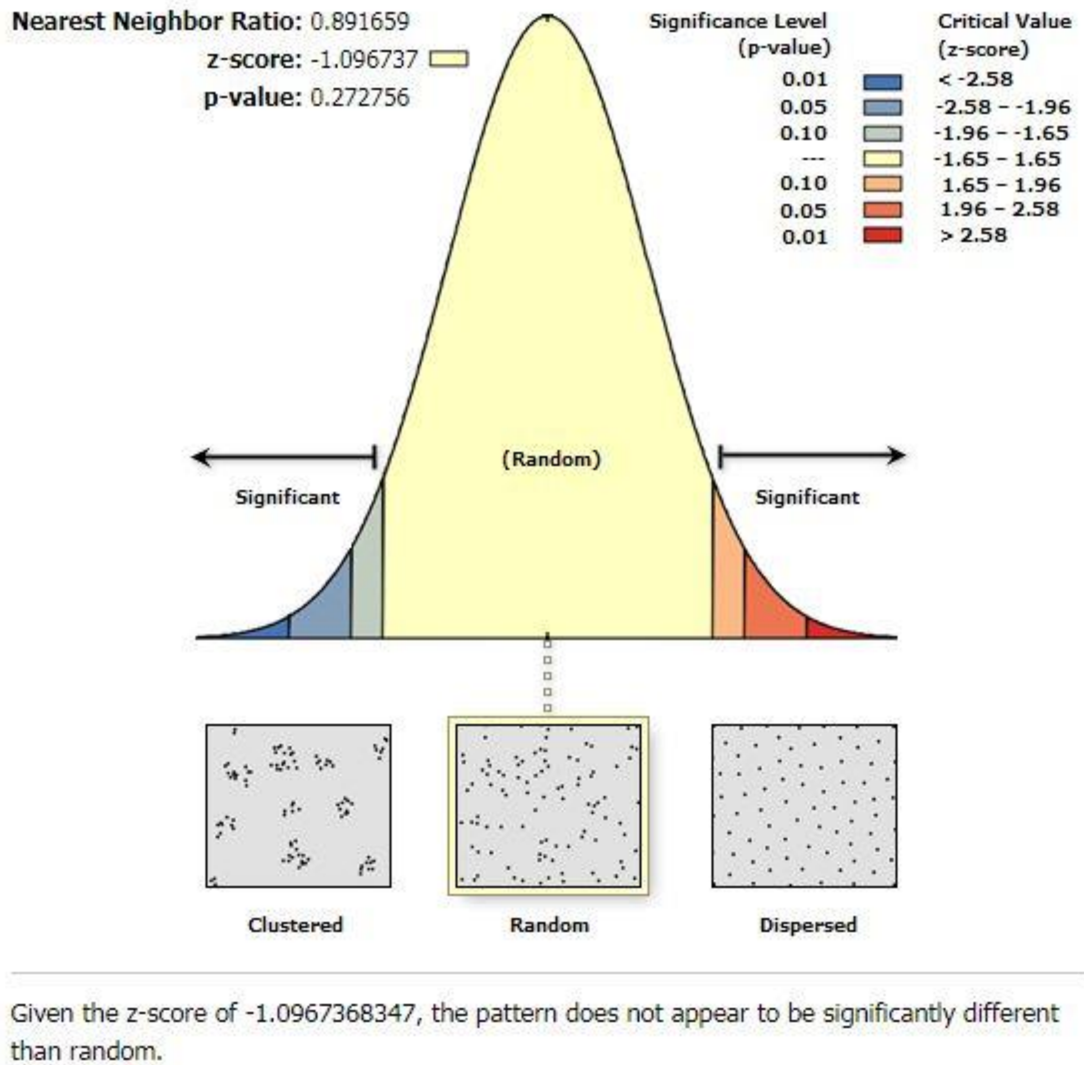


Figure 7.2 Results of the nearest neighbour test for utilized flakes recovered in Block A.

7.4.3 Cluster MRA3

Cluster MRA3 is a small cluster containing 12 artifacts made of red siltstone, sandstone and red chert. Very little can be said of this cluster as it contained mainly flake fragments with a single piece of shatter, a re-sharpening flake, and one decortification flake. Four retouched flakes made of quartzite, black chert, and argillite were distributed in the same location as cluster MRA3 but were not included in the cluster. There is no evidence to suggest that the retouched flakes are related to the artifacts in cluster MRA3, but the possibility does exist. The artifacts within the cluster suggest activities involving lithic working or manufacture.

7.4.4 Cluster MRA4

Cluster MRA4 contains a total of 135 artifacts made from a variety of raw materials, mostly of quartzite, although chert, quartz, salt and pepper quartzite, and black silicified quartzite artifacts are also present. A small percentage of the quartzite artifacts within the cluster displayed evidence of heat-alteration, but nothing significant enough to indicate the presence of a nearby hearth feature.

Cluster MRA4 coincides with the second cluster identified by Ives in Block A, cluster A2. Ives recorded one utilized flake, four retouched flakes, one core, three split pebble artifacts, and two endscrapers in cluster A2. This is similar to the composition of artifacts in cluster MRA4 with the exception of an extra endscraper and retouched flake. Figure 7.3 shows the distribution of endscrapers and retouched flakes in Block A in relation to cluster MRA4. One of the endscrapers is located close enough to cluster MRA4 that it could be considered as part of the cluster; however, there is little evidence to support including any other retouched flakes.

Cluster MRA4 also contained numerous flake fragments, shatter, decortification flakes, re-sharpening flakes, and a single bifacial reduction flake. The variety of artifact types and raw materials could mean that cluster MRA4 is representative of a refuse pile. However, the potential for cluster overlap or mixing is also a possibility.

The cluster is located in close proximity to cluster MRA2, and both clusters contain green and grey chert artifacts. The green and grey chert artifacts recovered from cluster MRA4 consist of one split pebble, ten flake fragments, two re-sharpening flakes, four decortification flakes, and one piece of block shatter. These artifacts are consistent with those recovered from cluster MRA2. Additionally, all the green and grey chert artifacts recovered from cluster MRA4 were of a similar vertical provenience as those recorded in cluster MRA2. In contrast, all other artifacts in cluster MRA4 were recovered from varying depths between 8 and 27 cmbd. Therefore, it is possible that the green and grey chert artifacts contained in cluster MRA4 should be considered as part of cluster MRA2 (Figure 7.4).

Sandstone artifacts contained in cluster MRA4 also show a slight difference in their distribution compared to other artifacts in the cluster. Only four sandstone artifacts occur in the cluster and they are located approximately 20 cm away from where most of the other artifacts are generally mixed together (Figure 7.5). This could be an indication that sandstone artifacts in cluster MRA4 were only included due to a statistical error.

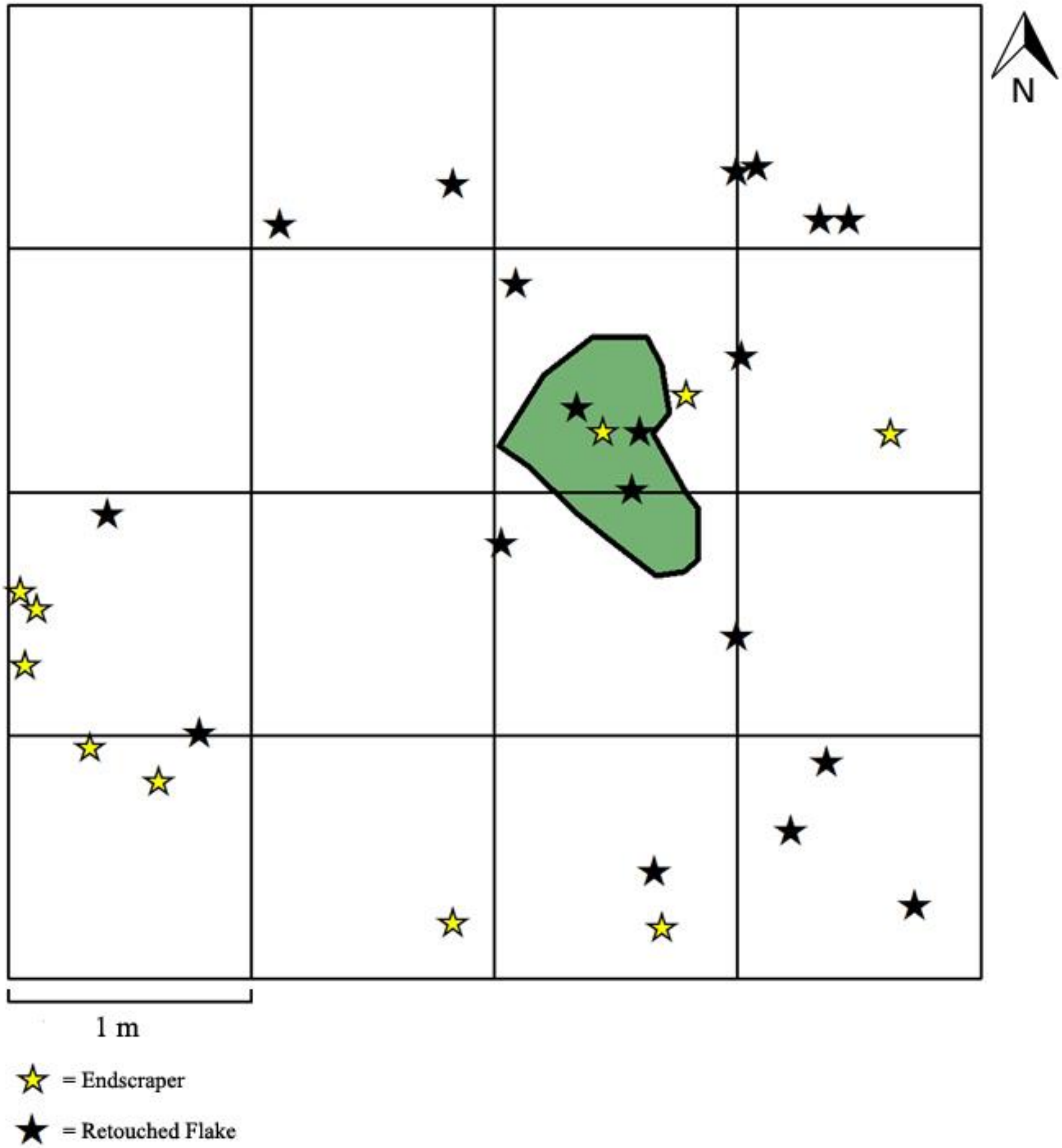


Figure 7.3 Distribution of endscrapers and retouched flakes in relation to Cluster MRA4.

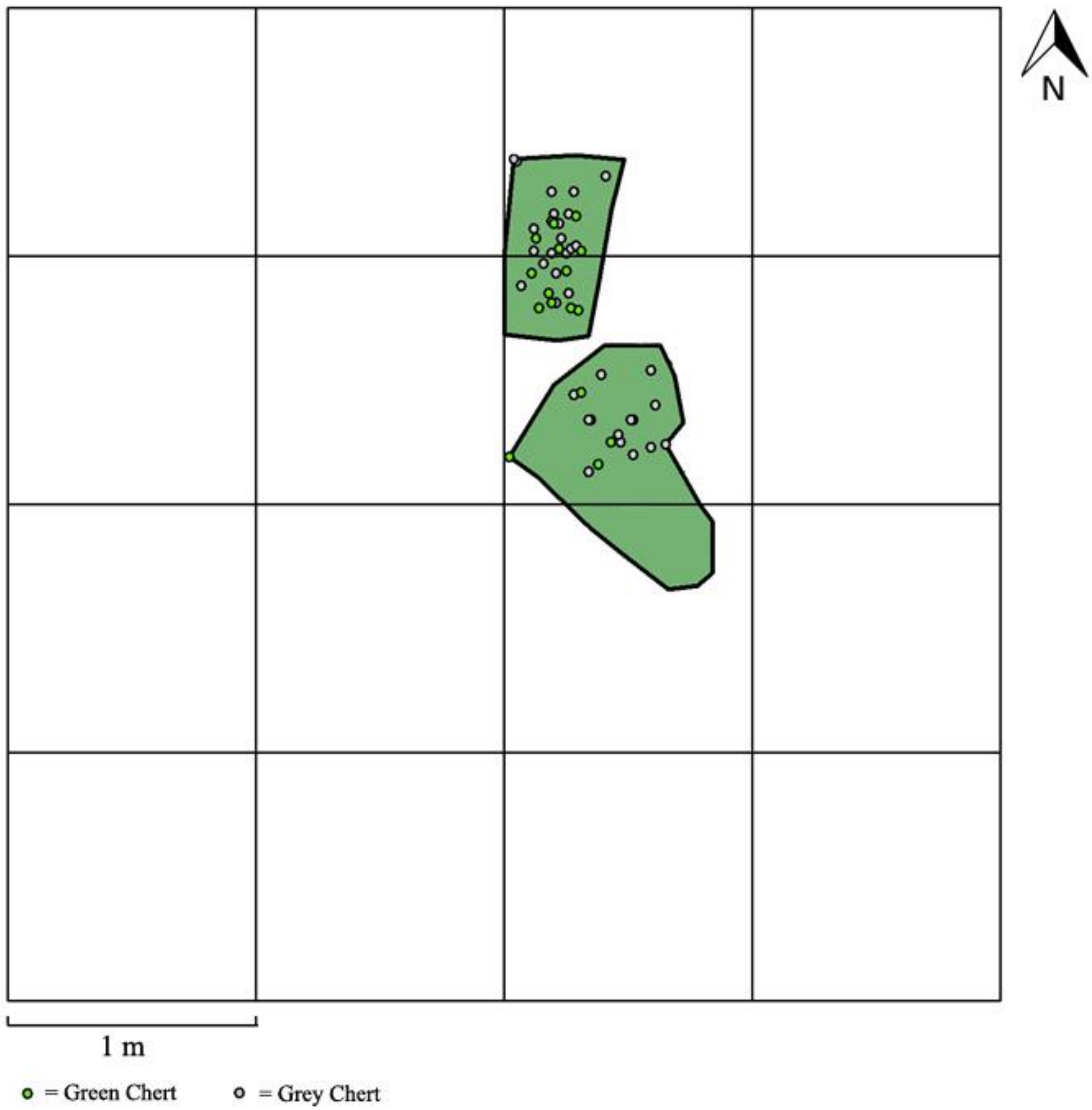


Figure 7.4 Distribution of green and grey chert artifacts in clusters MRA2 and MRA4.

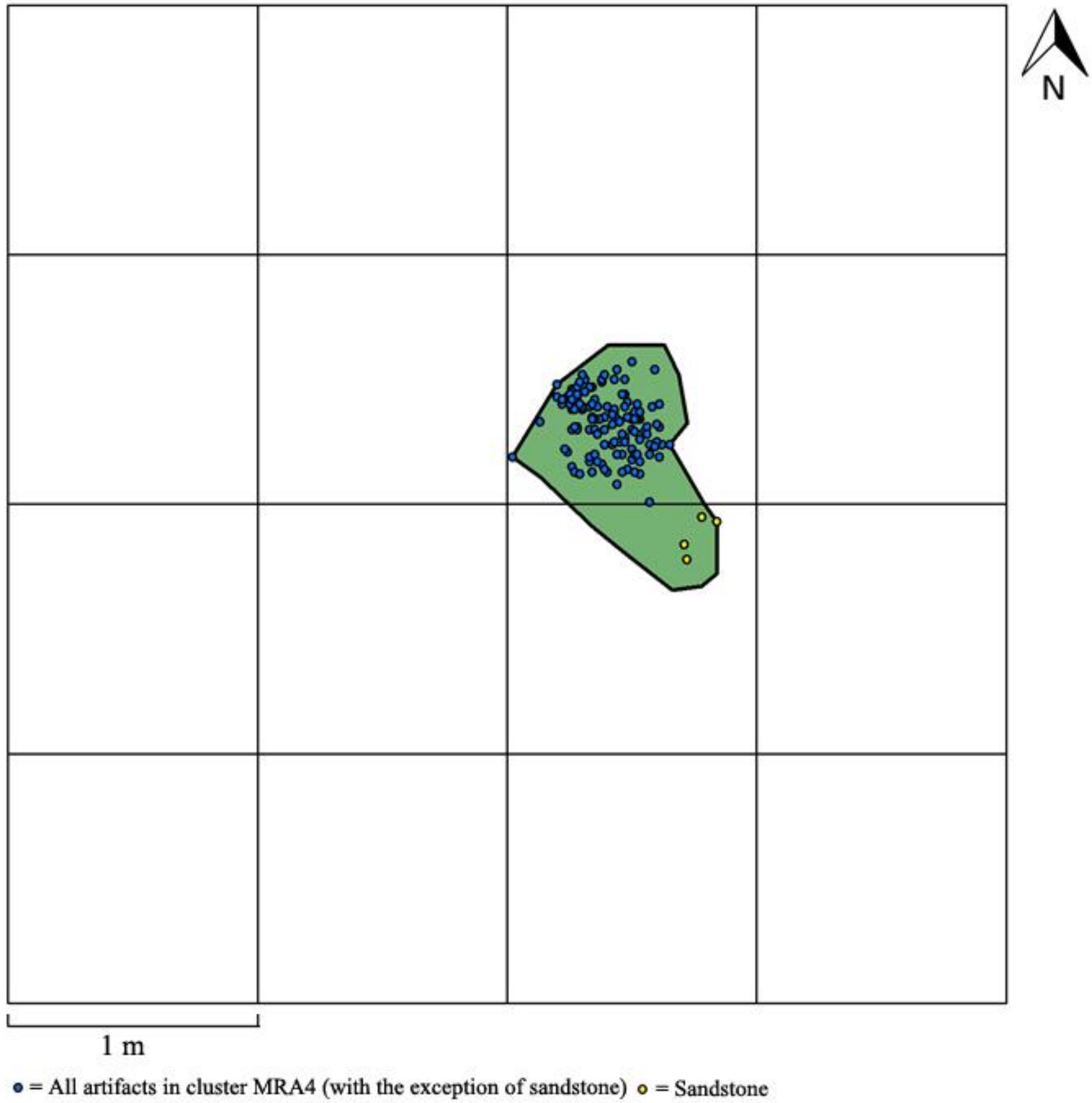


Figure 7.5 Distribution of sandstone artifacts in cluster MRA4 compared to the rest of the artifacts in the cluster.

Assuming the rest of the artifacts from cluster MRA4 belong together, interpretations can then be made regarding the cluster composition. The black silicified quartzite core coupled with flake fragments and shatter indicate that this was an area of stone tool manufacture. Given that no black silicified quartzite tools were recovered from the block, including any expedient tools, it can be assumed that any finished tools of this material were carried away. The large quantity of quartzite and black chert debitage is also indicative of lithic manufacture. The retouched flakes, endscrapers, and one utilized flake could be an indication that hide working or preparation also occurred here. It is possible that the large quantity of debitage in the cluster was created while re-working tools or creating expedient tools to assist with hide work. A second possibility exists that no hide working took place in this area, and the endscrapers, utilized and retouched flakes were simply used to cut and plane wood before hafting a tool.

7.4.5 Cluster MRA5

Cluster MRA5 is located on the western periphery of Block A and contains 87 artifacts. A high percentage of the artifacts are made of quartzite, with over half displaying signs of heat-alteration. Single pieces of black chert, grey chert, heat-altered salt and pepper quartzite, and coarse-grained quartzite are also contained within the cluster. The artifact distribution of cluster MRA5 becomes much denser closest to the edge of the block, which may indicate that more artifacts belonging to this cluster exist in an unexcavated portion of the site.

Cluster MRA5 also contains an unusually high percentage of endscrapers. In total, ten endscrapers were recovered from Block A and five of them are contained in this cluster. Endscrapers and quartzite artifacts have been found in association with numerous bone features excavated in the Athabasca oil sands region (Roskowski 2015; Roskowski and Netzel 2011; Roskowski and Netzel 2014). These artifacts may have been used in the processing of bone prior to roasting. Endscrapers also may have been used to plane small pieces of wood in order to make tinder for a fire. If this were the case, then one could infer that the heat-altered materials from cluster MRA5 are representative of a phantom or invisible hearth feature (Chapter 5, Section 5.3.6.1).

With only 48 of the 87 artifacts in cluster MRA5 showing evidence of heat-alteration and with no bone contained in the cluster, it is difficult to argue that it represents a hearth feature. However, additional heat-altered materials and even bone could exist in the unexcavated unit to the west. Furthermore, environmental conditions could have been inimical to the survival of faunal materials that may or may not have been associated with this cluster, and those remains are now non-existent. Hearth features are usually centers of human activity and if cluster MRA5 corresponds with the location of a hearth feature, then one would expect a diverse set of artifacts displaying the range of activities that took place. The only tools contained in cluster MRA5 are endscrapers, while the rest of the artifacts consist of lithic debitage.

However, many utilized and retouched flakes were located near cluster MRA5 and most of the bone recovered from Block A was recovered from units adjacent to the cluster. It is difficult to say with certainty, but if some of the retouched and utilized flakes are associated with cluster MRA5, then the evidence in favour of an invisible hearth becomes stronger. If the bone recovered from units adjacent to cluster MRA5 is associated with the hearth feature, then it could be an area where the processing of an animal took place prior to being roasted on a fire, or these materials could have been deposited away from the hearth in a toss zone. Much of the bone recovered from Block A appeared to be burned (Ives 1985:37). Figure 7.6 shows the distribution of bone artifacts and tools in relation to cluster MRA5.

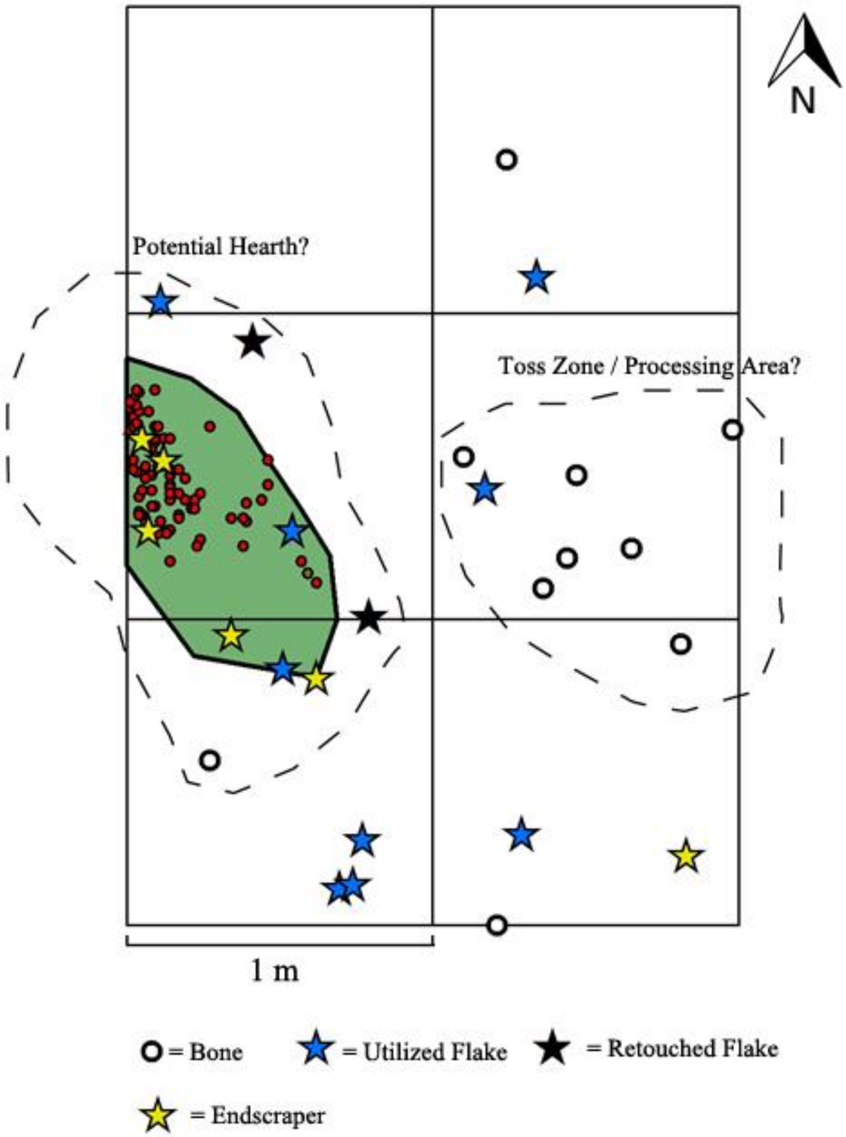


Figure 7.6 Distribution of bone, utilized flakes, retouched flakes, and endscrapers in relation to cluster MRA5.

If cluster MRA5 does represent an invisible hearth feature, then one would also expect evidence of a toss zone where larger artifacts were cast aside. Figure 7.7 shows the distribution of artifacts that are over 5 cm in maximum dimension. These artifacts mainly consist of debitage, but also include bone, two cores, two spall tools, one uniface and one utilized flake. The spall tools and uniface were found close to the bone artifacts, and these are tools that could be used for hide or animal processing, both activities that often would have taken place near a fire. All the artifacts that were 5 cm or larger in size are located anywhere from approximately 70 cm to 1.5

m away from the location of maximum artifact density in cluster MRA5. This supports the hypothesis that cluster MRA5 represents a hearth feature where animal processing and food preparation took place.

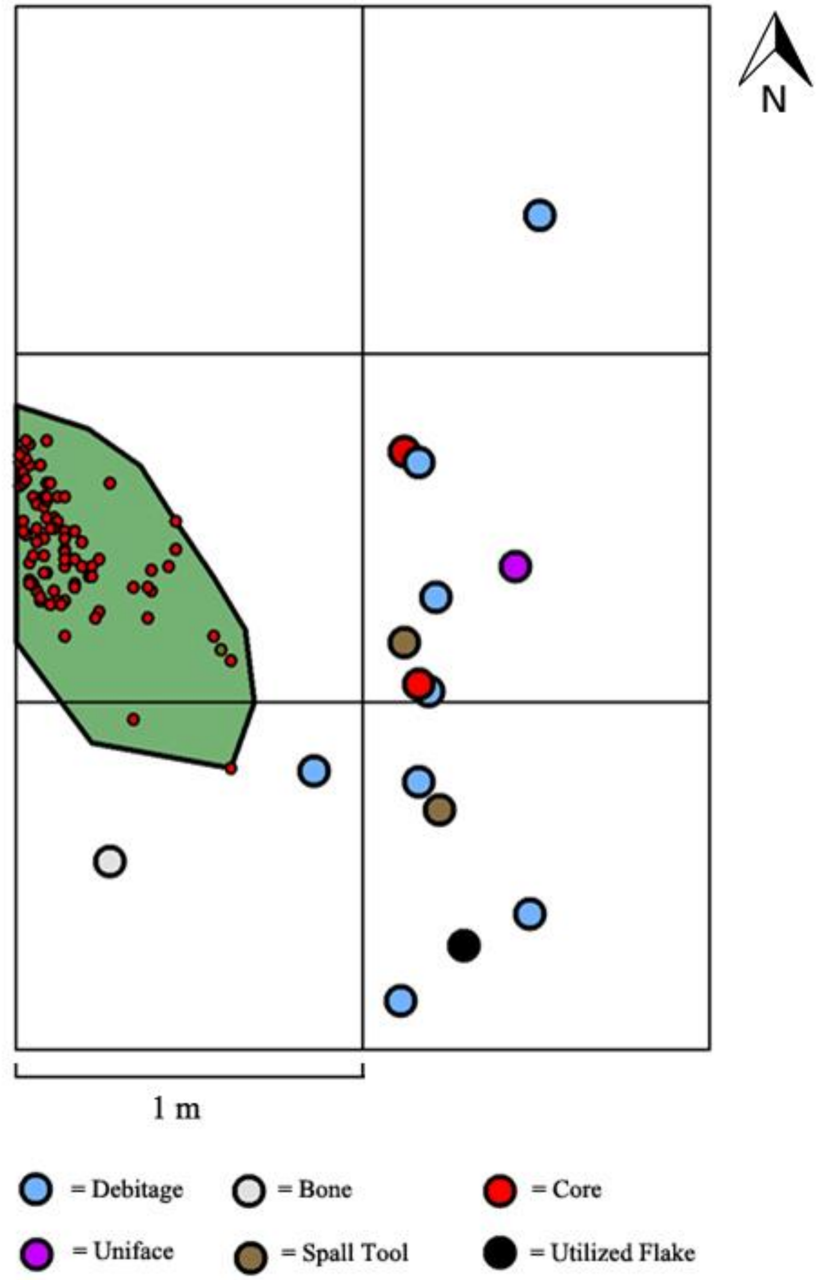


Figure 7.7 Distribution of large artifacts in relation to cluster MRA5.

An alternative hypothesis could simply be that the artifacts in cluster MRA5 represent an area of lithic reduction. The large percentage of heat-altered artifacts can be explained by the fact that a heat-treated quartzite core was worked here. In this scenario the endscrapers could represent an accumulation of artifacts that were manufactured in this spot and left behind, while the bone artifacts in the adjacent unit may be completely unrelated. Evidence for this scenario is supported by the fact that bone artifacts were deemed to be randomly distributed in the block according to the nearest neighbour test (Chapter 6, Section 6.2.2.2; Figure 6.5). Faunal remains from Block A were also only associated with shallow depths, whereas artifacts from cluster MRA5 tended to be more broadly distributed in their vertical provenience.

7.4.6 Cluster MRA6

Cluster MRA6 is adjacent to cluster MRA5 and corresponds with the location of the potential toss zone. This is the largest cluster in Block A, incorporating a total of 289 artifacts. Most of the artifacts are made of quartzite although lesser amounts of grey chert, quartz, sandstone, Peace Point Chert, and red siltstone are also present. Tools in the cluster consist of a uniface, a spall tool, and a side scraper. All of these tools are often associated with hide working but could also be used in wood working or the processing of animal remains. The debitage includes flake fragments, re-sharpening flakes, decortification flakes and shatter. This, coupled with the heat-altered core is evidence that this was an area of lithic reduction or stone tool manufacture.

The large number of artifacts in cluster MRA6, representative of various activities and the accumulation of numerous raw material types could be an indication of cluster overlap, or mixing. It also could mean that artifacts in cluster MRA6 are remnants of a refuse pile. If cluster MRA5 is truly a hearth feature, then the idea of cluster MRA6 as a refuse pile is a strong possibility. However, it is also possible that cluster MRA6 contains artifacts of different occupations that were mixed together. Cluster overlap with the artifacts in cluster MRA7 is also a distinct possibility (described in more detail below).

7.4.7 Cluster MRA7

Cluster MRA7 is located directly adjacent to cluster MRA6 and contains a total of 193 artifacts. A variety of raw materials exist in the cluster including quartzite, quartz, Peace Point Chert, grey chert, sandstone, salt and pepper quartzite, and BRS. The only tools in the cluster are made of quartz and include one utilized flake and two spall tools. The rest of the artifacts consist of debitage including flake fragments, shatter, re-sharpening flakes, bifacial reduction flakes, and decortification flakes. The cluster also contains a single split pebble artifact made of grey chert. Cluster overlap or mixing is strongly suspected in cluster MRA7.

Quartz artifacts in the cluster are tightly compacted together and likely represent a single event or activity (Figure 7.8). Quartz debitage in the cluster includes flake fragments, shatter, and decortification flakes. The spall tools and utilized flake are expedient tools that may have been quickly created to process wood, a hide, or an animal carcass.

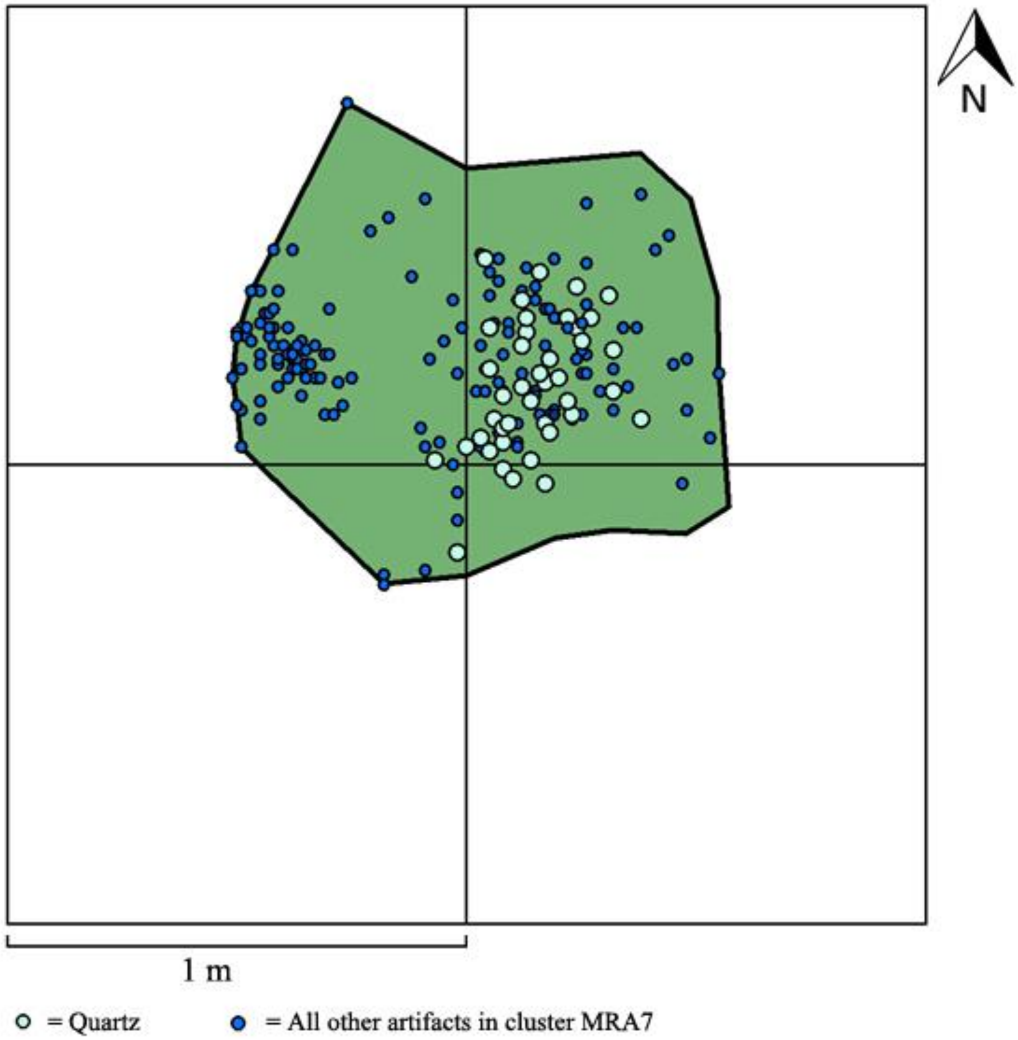


Figure 7.8 Distribution of quartz artifacts in cluster MRA7

Some of the artifacts contained in cluster MRA6 appear to relate to artifacts in cluster MRA7, which may be an indication of cluster overlap or mixing. For instance, some of the flake fragments recovered from cluster MRA7 are spatially distributed in such a way that they appear to be more strongly associated with the ones from cluster MRA6 (Figure 7.9). This may be representative of a weakness with the K-means algorithm, in that artifacts belonging to one cluster were grouped with another (Chapter 5, Section 5.3.5.4).

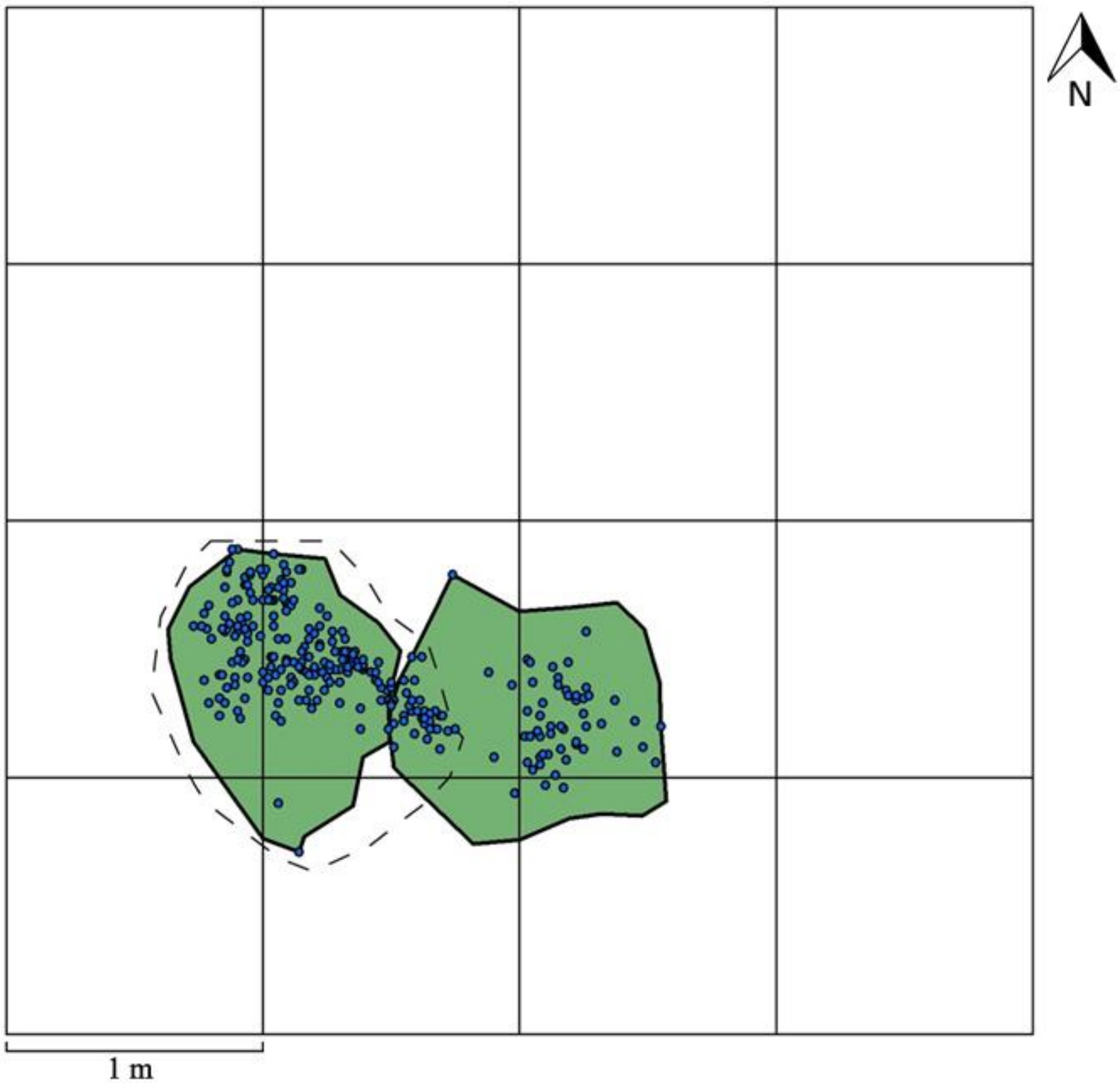


Figure 7.9 Distribution of flake fragments in cluster MRA6 and MRA7. Some of the flake fragments from cluster MRA7 appear spatially, to be more strongly associated with ones from cluster MRA6 (represented by dotted line).

Peace Point Chert artifacts are contained in both clusters MRA7 and MRA6. The distribution of these artifacts is such that they are divided into two groups by the quantitatively determined border between the two clusters (Figure 7.10). This could be an indication that Peace

Point Chert artifacts in cluster MRA6 and MRA7 are related and represent a single event. Peace Point Chert artifacts from cluster MRA6 consist of flake fragments and bifacial reduction flakes, whereas the ones from cluster MRA7 consist of flake fragments, decortification flakes, re-sharpening flakes, and shatter. Together, the Peace Point Chert artifacts contained in cluster MRA6 and MRA7 represent a process of stone tool manufacture. Since Peace Point Chert is not native to the Birch Mountain region the material was likely brought into the site from afar and any tools of it were likely carried away.

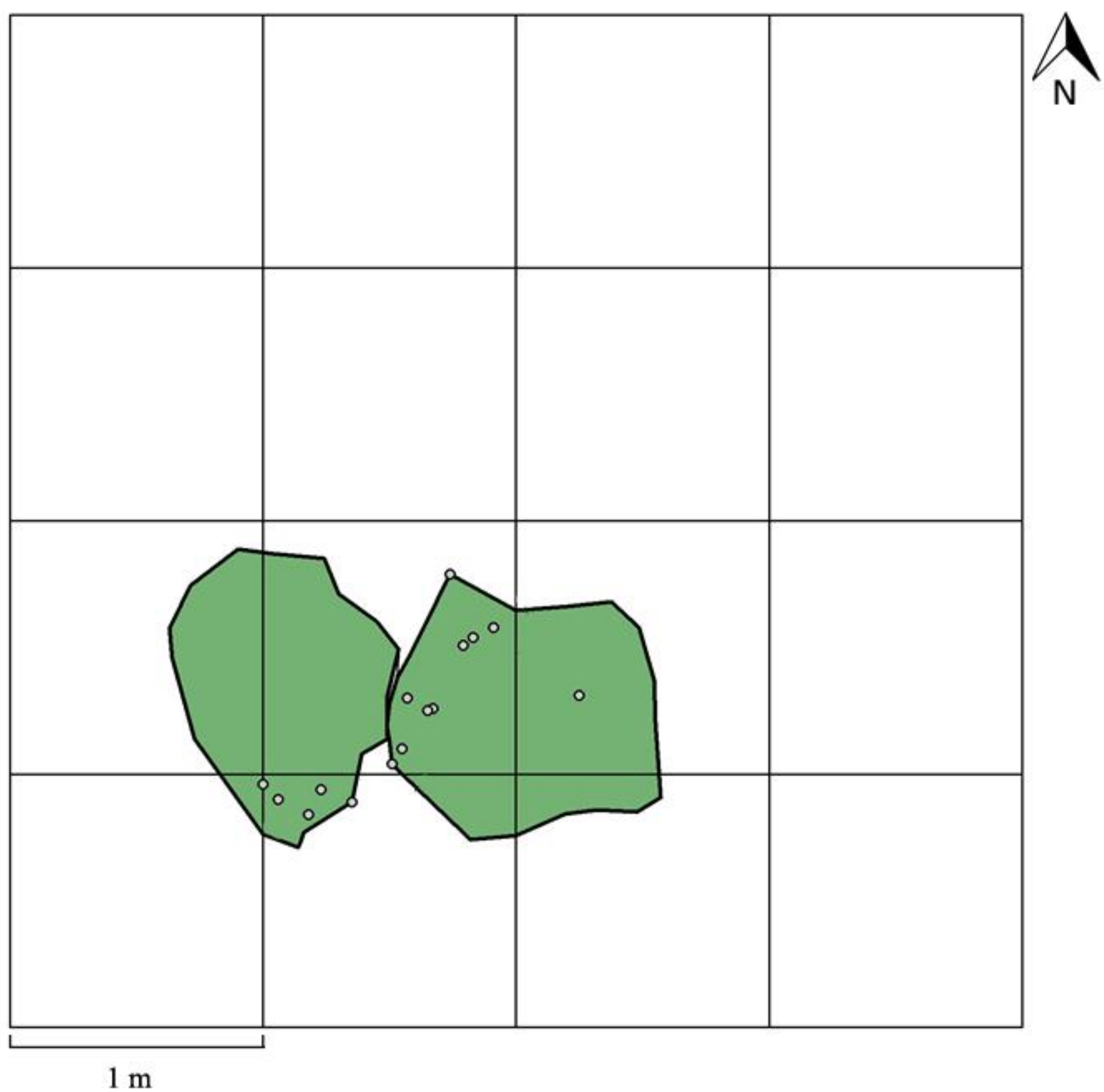


Figure 7.10 Distribution of Peace Point Chert artifacts contained in cluster MRA6 and MRA7.

Combined, clusters MRA6 and MRA7 contain the highest concentration of artifacts of all the clusters identified in Block A. Two different scenarios could explain why this is the case. The first scenario is that the clusters are representative of cluster overlap or mixing of multiple occupations. A second scenario could be that both the clusters are refuse piles. Very few tools are contained in these clusters, which makes it difficult to make any significant function-related interpretations. However, assuming a flintknapper or a group of flintknappers were working a variety of material types and collecting the debitage on a mat or skin, it would be expected that these materials are periodically thrown to the side. This explanation could account for the predominance of debitage and general lack of tools. It is also possible that a refuse pile was placed on top of an activity area from a separate occupation. For these reasons, cluster overlap in cluster MRA6 and MRA7 is strongly suspected.

7.4.8 Cluster MRA8

Cluster MRA8 is a small cluster containing only 16 artifacts. Quartzite, sandstone, coarse-grained quartzite, and quartz are contained in the cluster. Despite being small, cluster MRA8 contains many expedient tools including four spall tools, two utilized flakes and one retouched flake. Debitage includes flake fragments and shatter. The tools in the cluster suggest hide or wood working. The spall tools could have been used to soften, or scrape hide, and the utilized and retouched flakes could have been used as scraping instruments.

7.4.9 Cluster MRA9

Cluster MRA9 contains 104 artifacts made of quartzite, BRS, quartz, black chert, and Peace Point Chert. Despite containing a variety of raw material types around 77 percent of the artifacts in this cluster are made of quartzite. One endscraper makes up the entire tool assemblage of the cluster. Debitage is mainly made up of flake fragments, and re-sharpening flakes, although lesser amounts of shatter, bifacial reduction flakes, and decortification flakes also exist in the cluster. One hammerstone made of coarse-grained quartzite and one quartzite wedge overlap with the cluster but were not statistically included in the cluster composition.

The general lack of tools in the cluster and the high proportion of lithic debitage suggest this was an area of lithic manufacture. The hammerstone may have been used to reduce a core which explains the decortification flakes. The high number of re-sharpening flakes suggest that a finished tool was retouched. However, the only tool left behind was a single endscraper.

7.4.10 Block A Summary

A total of nine clusters were identified in Block A. The clusters allowed for a range of discrete activities to be identified. For instance, cluster MRA1, which consisted entirely of small BRS artifacts, likely represents a single episode of stone tool manufacture. The inclusion of tools such as endscrapers, spall tools, and retouched and utilized flakes in many of the clusters allows for a range of activities to be postulated. The vertical and horizontal arrangement of artifacts within clusters suggested that at least some of these activities were from separate occupations. For instance, the green and grey chert artifacts contained in clusters MRA2 and MRA4 could be from a more recent occupation than other artifacts within the block. The distribution of heat-altered materials allowed for the identification of a potential hearth feature in cluster MRA5, although it may also just be an area where a heat-treated core was reduced. Even in areas where cluster overlap or mixing was strongly suspected and where the vertical provenience of artifacts are of no interpretive value, such as in clusters MRA6 and MRA7, the analysis of artifacts of a single raw material can aid in interpretation. For instance, even if the artifacts contained in cluster MRA7 are the result of cluster mixing, the quartz artifacts were likely from a single event of a flintknapper working a quartz core or tool. From this perspective, the analysis of Block A has been greatly enhanced by the methods employed to identify spatial clusters of artifacts.

7.5 Block B

A total of five horizontal spatial clusters were identified in Block B. Ives (1985) also defined five clusters within the block and suggested that there was very little evidence of cluster overlap. The block is characterized by a moderate density of artifacts with a high percentage of quartzite.

7.5.1 Cluster MRB1

Cluster MRB1 contains 99 artifacts made mostly of quartzite, but also including black chert, grey chert, salt and pepper quartzite and Peace Point Chert. Many tools are included in the cluster including two projectile points, the base of one projectile point, a biface, one retouched flake, and one utilized flake. Debitage includes flake fragments, re-sharpening flakes, decortification flakes, and shatter.

Cluster MRB1 corresponds with one of the clusters defined by Ives, cluster B5. The tools of each cluster are similar, except for two additional quartzite endscrapers included in Ives' cluster. Figure 7.11 shows the distribution of endscrapers in relation to cluster MRB1. Two of the endscrapers are located near enough to cluster MRB1 that they could potentially be considered as part of the cluster.

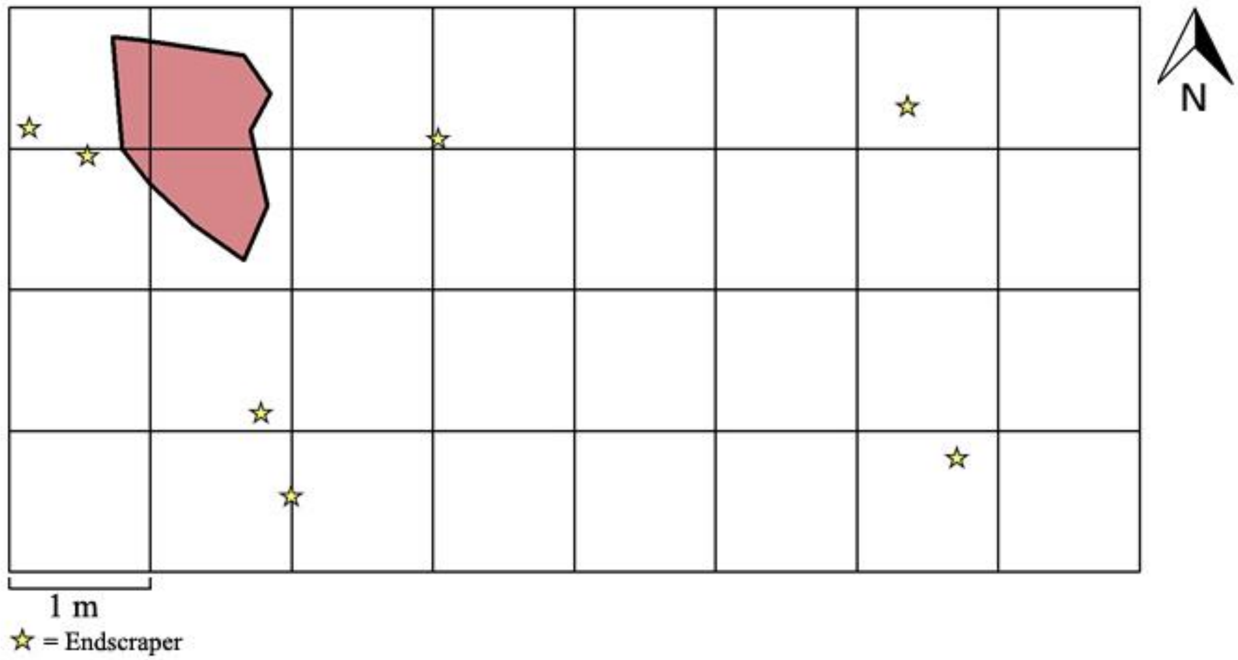


Figure 7.11 Distribution of endscrapers in relation to cluster MRB1.

Two side-notched projectile points and the base of a side-notched projectile point are included in cluster MRB1 (Figure 7.12). Ives (1985:87) suggested that these projectile points are reminiscent of artifacts from the late Taltheilei tradition (Chapter 4, Section 4.2.2.4). Both completed projectile points share several features including basal thinning, grinding, and convergent diagonal flaking.

The major differences between the two points is the less pronounced side-notching and the elaborated and asymmetrical blade seen on specimen HkPa 4:41:32.

Figure 7.12 Projectile points contained in cluster MRB1 (From left to right HkPa 4:40:1, HkPa 4:41:32, HkPa 4:41:19).

The large quantity of debitage in cluster MRB1 suggests it was an area of stone tool manufacture. The projectile point base may represent breakage and discard of a complete point being made or undergoing retouch, or discard of the base only as part of re-hafting a shaft with a broken tip. The quartzite biface contained in the cluster exhibits some degree of edge sinuosity but was broken and likely discarded during manufacture. The utilized and retouched flakes are expedient tools that may have been used for a variety of purposes, including but not limited to, the working of wood for the purpose of hafting completed tools.

7.5.2 Cluster MRB2

Cluster MRB2 contains a total of 109 artifacts made mainly of quartzite but also containing salt and pepper quartzite, Peace Point Chert, and argillite. A small percentage of the quartzite show evidence of heat-alteration, but nothing significant enough to warrant the possibility of an invisible hearth feature. A more likely scenario is that a heat-treated piece of quartzite or a heated quartzite tool was worked here. A single quartzite endscraper was the only tool contained in the cluster which otherwise was made up of flake fragments, bifacial reduction flakes, re-sharpening flakes, shatter, and a core. The high number of quartzite flake fragments and a quartzite core suggest this was an area of stone working where a core was reduced. The re-sharpening flakes are evidence of the final retouches on a finished tool.

7.5.3 Cluster MRB3

Cluster MRB3 contains a total of 93 artifacts made of quartzite, argillite, grey chert, and red chert. A single quartzite projectile point was contained in the cluster (Figure 7.13), which Ives initially described as a “square-based lanceolate point, that compares favorably with the Middle Taltheilei period” (Ives 1985:87). Ives (2017) later noted that the artifact closely resembles materials which were excavated from Component II at Dry Creek, Alaska where associated material was radiocarbon dated to 10,000 to 10,600 B.P. Other artifacts in the cluster include two retouched flakes, one core, flake fragments, bifacial reduction flakes, decortification flakes, and shatter.

The location of cluster MRB3 corresponds with the approximate location of two clusters defined by Ives, cluster B1 and cluster B2 (Ives 1985:84) (Figure 7.14). Ives` cluster B1 contained two retouched flakes, one utilized flake, one core, and one hammerstone. Cluster B2 contained three retouched flakes, one core, one projectile point, and one spall tool. Some of the artifacts in Ives’ clusters correspond with artifacts contained in cluster MRB3, but most do not. Cluster MRB3 was also located in a location of the block where numerous refits were located (Chapter 6, Figure 6.18). The horizontal proximity of the refits to each other suggests that minimal horizontal mixing of artifacts occurred here. The close proximity of all three of the clusters could indicate that they are related. However, if they are not related, then this indicates an area where cluster mixing or overlap may have occurred.

Artifacts contained in cluster MRB3 were mainly debitage with a limited number of tools. The core and decortification flakes indicate that cluster MRB3 was in an area of lithic reduction where a core was being reduced. The hammerstone identified in the cluster defined by Ives may have been used to reduce the core. The retouched flakes and utilized flakes could have been used for a variety of cutting or scraping purposes. A single endscraper was also located near the cluster but was not included in the composition of cluster MRB3 or the clusters identified by Ives. Quartzite contained in the cluster, including the projectile point, the exhausted core, and much of the debitage, was distinctive in that it contained globular impurity providing an additional line of evidence that these artifacts are related to one another (Ives 2017:295; Figure 7.13)

Figure 7.13 Oblanceolate projectile point contained in Cluster MRB3 (Photograph courtesy John W. Ives).

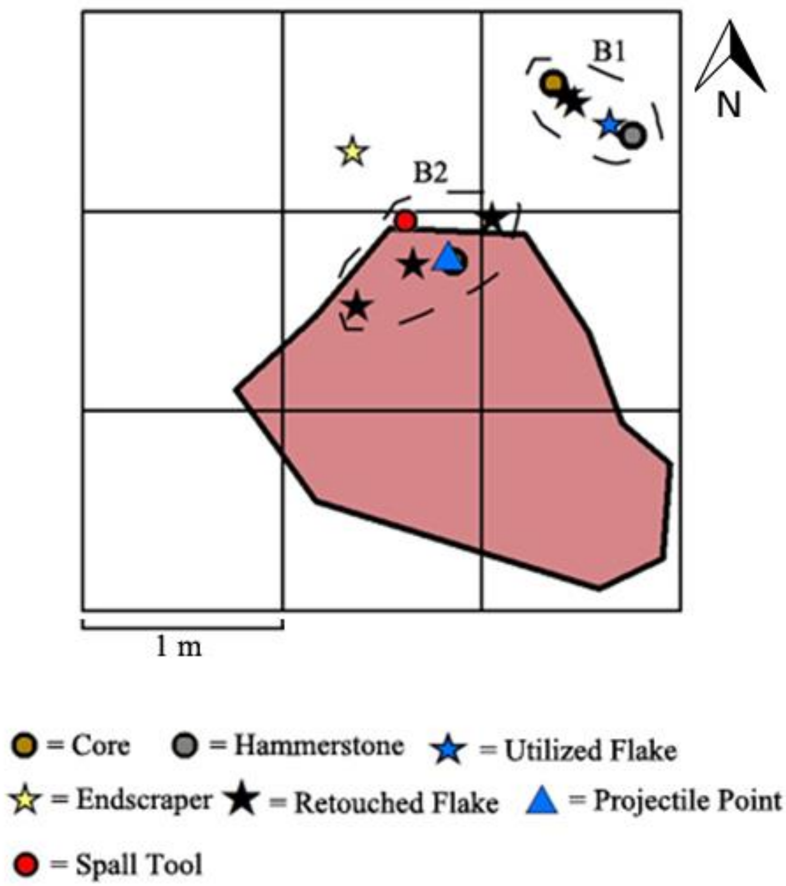


Figure 7.14 Location of artifact clusters B1 and B2 defined by Ives (indicated by dotted lines) in relation to cluster MRB3.

7.5.4 Cluster MRB4

Cluster MRB4 is a small cluster of ten artifacts. All the artifacts contained in the cluster are made of coarse-grained quartzite or Peace Point Chert. No tools are contained in the cluster; however, the cluster does line up with Ives' cluster B4 (Ives 1985:84). Ives' cluster B4 contained a total of five artifacts including one retouched flake, one core, two endscrapers, and one uniface (Figure 7.15). All the artifacts in the cluster defined by Ives are made of quartzite. The different raw material types in the composition of the two clusters could indicate that this is an area where clusters overlap or mixing occurred. Alternatively, it is possible that the coarse-grained quartzite and Peace Point Chert were made into tools to replace the ones left behind and any tools made of Peace Point Chert or coarse-grained quartzite were carried away.

The endscrapers and uniface could indicate an area where hide working occurred, although it is also possible that they were used for cutting and planing wood. Even though the quartzite core in cluster B4 is of a different material type than the artifacts defined in cluster MRB4, it is consistent with the artifacts in that it represents an instance of lithic manufacture. Unfortunately, there is not enough evidence to determine if the cluster defined by Ives and cluster MRB4 are related or not.

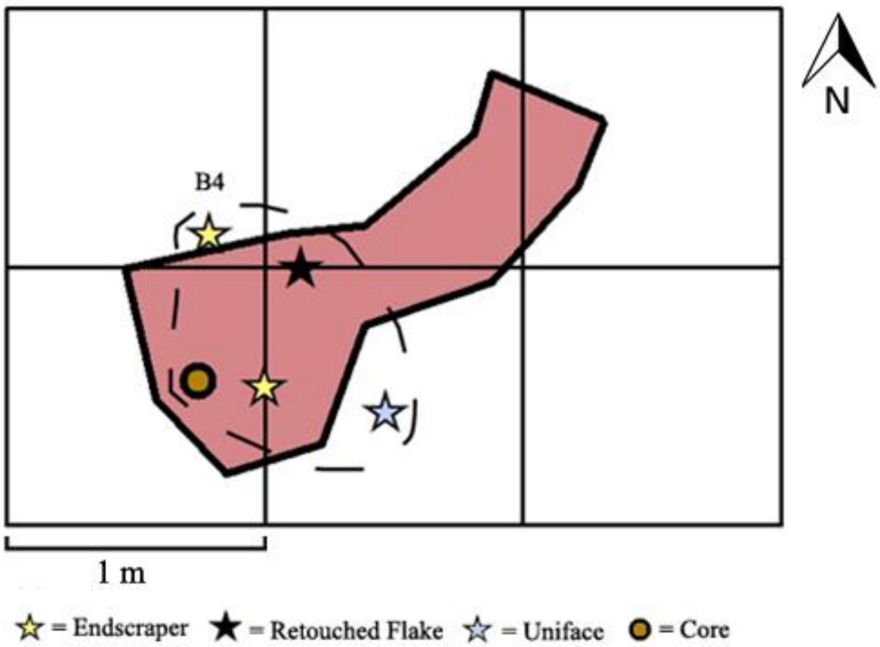


Figure 7.15 Location of a cluster B4 defined by Ives (indicated by the dotted lines) in relation to cluster MRB4.

7.5.5 Cluster MRB5

Cluster MRB5 contains a total of 32 artifacts. Most of the artifacts in the cluster are made of heat-altered quartzite, with small quantities of black and grey chert. Although most of the artifacts in cluster MRB5 show evidence of heat-alteration, there are a limited number of artifacts in the cluster, which makes it difficult to argue for an invisible hearth feature. However, many of the heat-altered artifacts are clustered near the southern wall of the excavation block, and further evidence of an invisible hearth feature could be in the adjacent unexcavated unit.

Artifacts from cluster MRB5 consist mainly of lithic debitage, including flake fragments, bifacial reduction flakes, shatter, re-sharpening flakes, decortification flakes, and split pebbles. No tools were located in the cluster. However, cluster MRB5 is in the same general area as the Ives' cluster B3. Ives' cluster contained two retouched flakes, two split pebble artifacts, one endscraper and one sidescraper. While the closest endscraper is located approximately 80 cm outside of cluster MRB5, two retouched flakes and one sidescraper do overlap with cluster MRB5's location (Figure 7.16). So it is possible that these artifacts could be considered as part of cluster MRB5.

The predominance of flake fragments, bifacial reduction flakes, and decortification flakes suggest that cluster MRB5 was an area of stone tool manufacture and lithic reduction. The retouched flakes, side scraper and endscraper defined in Ives' cluster could mean that other activities also took place in this area including wood work or hide work.

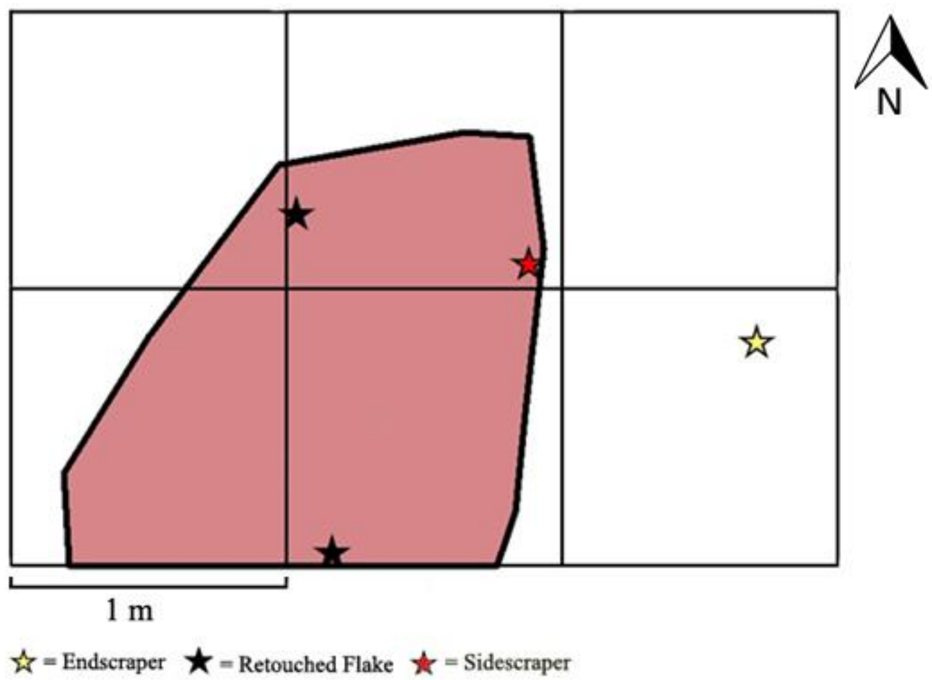


Figure 7.16 Location of retouched flakes, sidescrapers, and endscrapers surrounding cluster MRB5.

7.5.6 Block B Summary

Block B was an area of moderate artifact density in which a total of five clusters could be identified. At least three of the clusters identified through this study are in the same general vicinity as four of the clusters identified by Ives (1985). Cluster MRB1 contains a similar tool composition to Ives' cluster B5, including three diagnostic projectile points, all of which share a similar style. Cluster MRB3 is located close to Ives' clusters B1 and B2. Similarly, cluster MRB4 is located in the same area as Ives' cluster B4; however, the artifacts contained in the clusters are slightly different. There are two potential explanations for this occurrence. First, this could be due to a statistical problem due to the small sample size. This means that the tools contained in Ives' clusters were not statistically included in the clusters identified through this study. This does not necessarily mean the artifacts are not culturally related. It is possible that the tools identified in Ives' clusters were near the end of their uselife and were therefore replaced by new ones. However, the potential for cluster overlap or mixing cannot be ruled out. Despite these uncertainties, the spatial analysis of Block B allowed the designation of discrete sets of artifact clusters and allowed for the interpretation of several activity areas where tools were manufactured, or where animal processing, hide work or wood work took place. Furthermore, clusters MRB1 and MRB3 contained diagnostic artifacts from perceptibly different time frames. The projectile point contained in cluster MRB3 may be as old as 10,000 years, whereas the projectile points contained in cluster MRB1 are arguably from a more recent occupation. Ives (1985) has argued that spatial analysis in moderate density situations such as that in Block B is where we stand the best chance of parsing distributions that are otherwise tough to identify in high density areas such as Block A, where cluster overlap is more likely to have occurred. This is contrary to typical excavation techniques in the boreal forest today, where archaeologists have a tendency to chase higher artifact densities.

7.6 Block C

Block C is an area of high artifact density, with a total of 2112 artifacts recovered. A total of 8 artifact clusters were defined in Block C. Ives (1985:107) suggested that the eastern half of the block showed no significant patterning in the distribution of artifacts and hypothesized that the western half of the block was weakly to moderately patterned. Ives (1985) also defined eight clusters in Block C; however, the clusters defined by Ives are located only in the western half of the block. In contrast, the clusters identified through this study were located throughout the entire block.

7.6.1 Cluster MRC1

Cluster MRC1 is located in the northwest section of Block C and contains a total of 46 artifacts. Most of the artifacts are made of quartzite, although lesser amounts of BRS, grey chert, white chert, Peace Point Chert, coarse-grained quartzite, and salt and pepper quartzite are also contained in the cluster. Tools include one projectile point, three utilized flakes, two retouched flakes and two spall tools. Debitage consists of flake fragments, decortification flakes, re-sharpening flakes and shatter.

The projectile point in cluster MRC1 is made of quartzite and has a distinctive flared base which is convex, heavily ground, and thinned (Figure 7.17). The projectile point is reminiscent of points from the Fort Creek Fen complex, which dates between 9,900 to 9,400 B.P. (Reeves et al. 2017; Chapter 4, Section 4.3.2). However, the base of the projectile point is also like the base of an elongated projectile point recovered from the Karpinsky site, where associated material was radiocarbon dated to 1070 ± 55 B.P. (Bryan and Conaty 1975, Plate 3a). The depth of this projectile point was recovered from 33 cmbd which was deeper than most other projectile points recovered from Block C. This could arguably be an indication that the point is older than most other points recovered from this block, although it also may have been moved through bioturbation.

Figure 7.17 Projectile Point contained in cluster MRC1.

Cluster MRC1 coincides with the approximate location of two of the clusters defined by Ives, clusters C5 and C6 (Ives 1985:84). Cluster C5 contained two utilized flakes, two retouched flakes, one endscraper and one projectile point, and cluster C6 contained one utilized flake, one spall tool and two cores. The composition of both of Ives' clusters are similar to cluster MRC1 with the exception of the two cores and one endscraper. Figure 7.18 shows the distribution of cores and endscrapers in Block C. One endscraper fashioned out of BRS is located to the north of cluster MRC1. Cluster MRC1 contains one utilized flake and one flake fragment both of BRS, so it is possible that the endscraper could be associated with these artifacts.

Two cores are located close to cluster MRC1. One is a quartzite core located approximately 90 cm to the south, and there are no indications that it should be included in the cluster. The other core overlaps with cluster MRC1 and is made of white chert. One white chert decortification flake was contained in cluster MRC1, and therefore the core could be associated with that artifact.

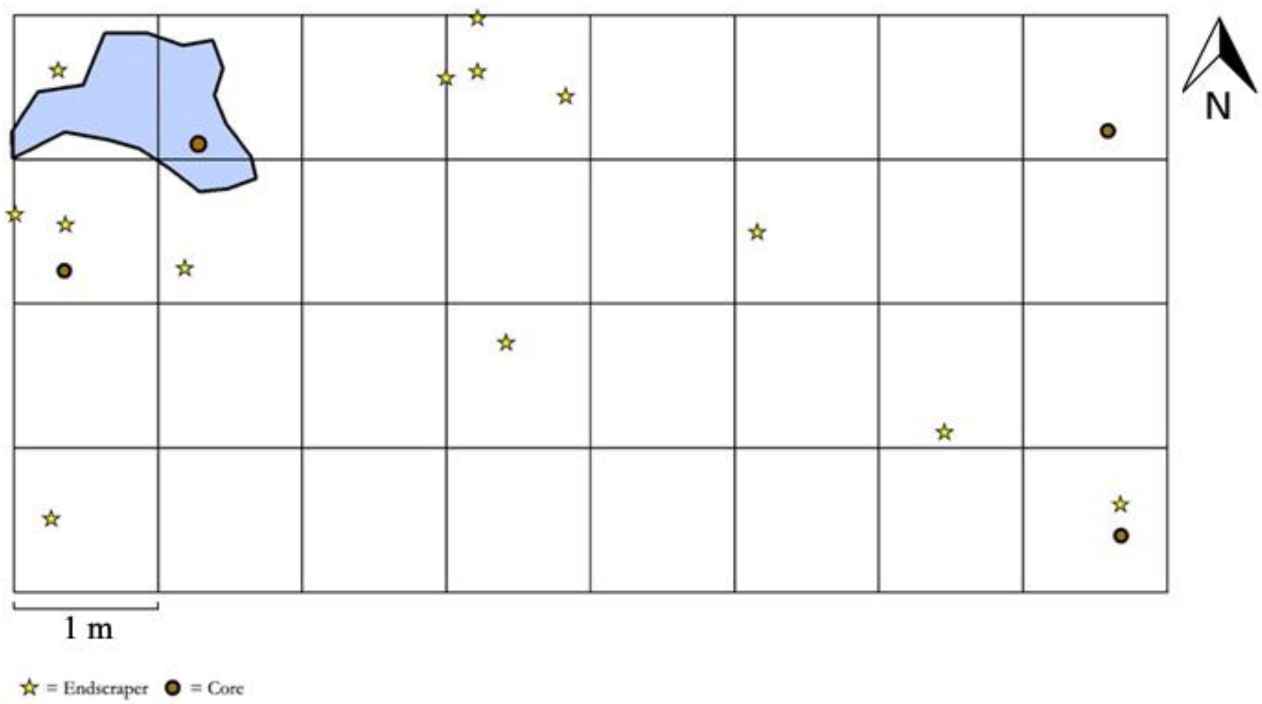


Figure 7.18 Distribution of cores and endscrapers in relation to cluster MRC1.

The high percentage of debitage including decortification flakes and flake fragments coupled with the white chert core indicate that cluster MRC1 was an area of lithic reduction and stone tool manufacture. However, the spall tools and BRS endscraper suggest hide working or processing. Given the variety of different raw material types, it is possible that cluster MRC1 contains cluster overlap or mixing of two different activity areas.

7.6.2 Cluster MRC2

Cluster MRC2 contains 282 artifacts made of quartzite, salt and pepper quartzite, coarse-grained quartzite, Peace Point Chert, grey chert, BRS, and quartz. A high percentage of the quartzite and salt and pepper quartzite artifacts contained in cluster MRC2 are heat-altered. Two bone tools are in the cluster, and numerous pieces of bone were located around the cluster, though only one is included in the cluster (Figure 7.19).

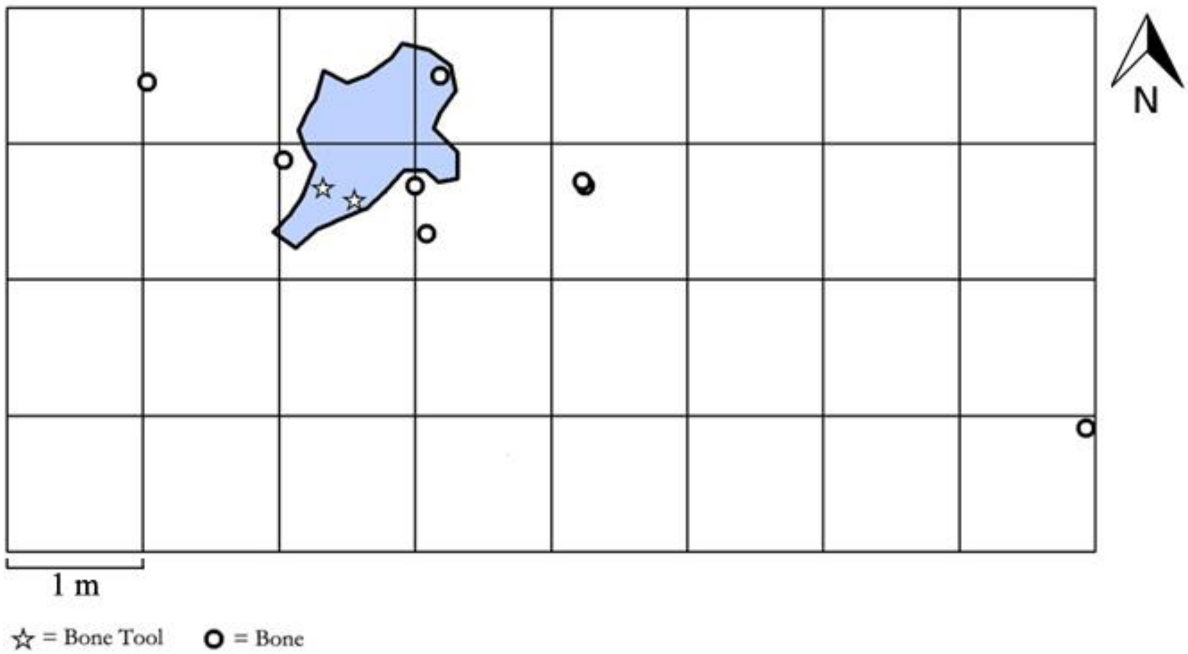


Figure 7.19 Location of bone tools and bone artifacts in relation to cluster MRC2.

Lithic materials from the cluster include two quartzite endscrapers, one coarse-grained quartzite spall tool, and numerous pieces of debitage including flake fragments, decortification flakes, bifacial reduction flakes, shatter, and one re-sharpening flake.

Cluster MRC2 coincides with the approximate location cluster C2, defined by Ives (Ives 1985:84). This cluster included one bone tool and three endscrapers. Figure 7.20 shows the distribution of endscrapers near cluster MRC2. Numerous quartzite endscrapers are located near the cluster and could very well be associated with it.

The large quantity of heat-altered material coupled with the fact that numerous bone artifacts were recovered from cluster MRC2 indicate that it may be an invisible or phantom hearth feature. Fire broken rock was collected from near cluster MRC2, but it was not recorded in situ. Like cluster MRA5 (Section 7.4.5), a high number of endscrapers were found in close proximity to the cluster and endscrapers have been noted to be found in association with bone features in the Athabasca oil sands region (Roskowski 2015; Roskowski and Netzel 2011; Roskowski and Netzel 2014).

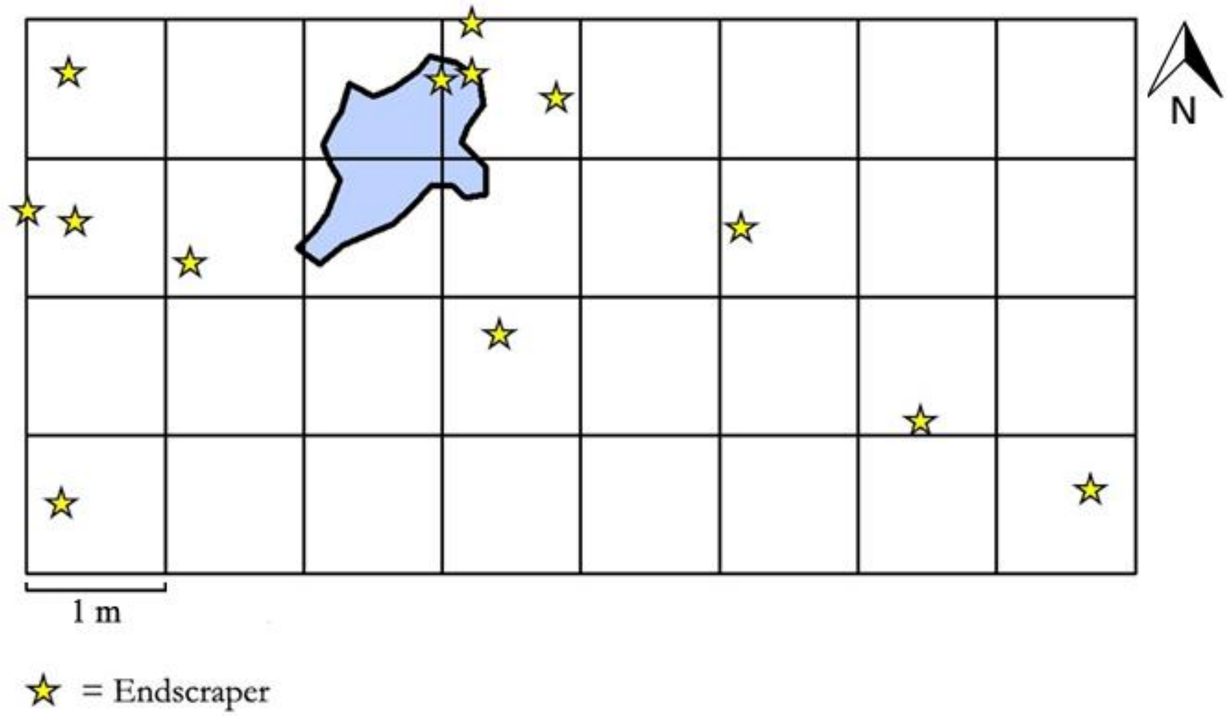


Figure 7.20 Distribution of endscrapers in relation to cluster MRC2.

If cluster MRC2 is an invisible hearth feature one would expect to find a variety of artifacts representing the different activities that would have likely taken place next to the hearth. Additionally, there might be evidence of a toss zone where larger artifacts were cast aside from the workspace. Figure 7.21 shows the distribution of artifacts that are 5 cm or greater in size from the units surrounding cluster MRC2. Only a few artifacts are found surrounding the cluster in this size category. Some of the large artifacts are located close to the cluster of heated materials; however, most artifacts are located anywhere from 60 cm to 1.5 m away from where artifact density in cluster MRC2 is the greatest.

Figure 7.22 shows the distribution of tools surrounding cluster MRC2. Numerous tools were found surrounding the cluster, which is what would be expected if it were a hearth feature. The tools consist of endscrapers, biface fragments, and retouched and utilized flakes. Interestingly the tools appear to make a circular pattern around the cluster of heated materials, and all the tools that are contained within the cluster tend to be located to the outside edge of the cluster and not mixed in with the heated materials. But it is also very possible that many of these tools are completely unrelated to the cluster, as a high number of artifacts were recovered from the block and may reflect multiple episodes of occupation.

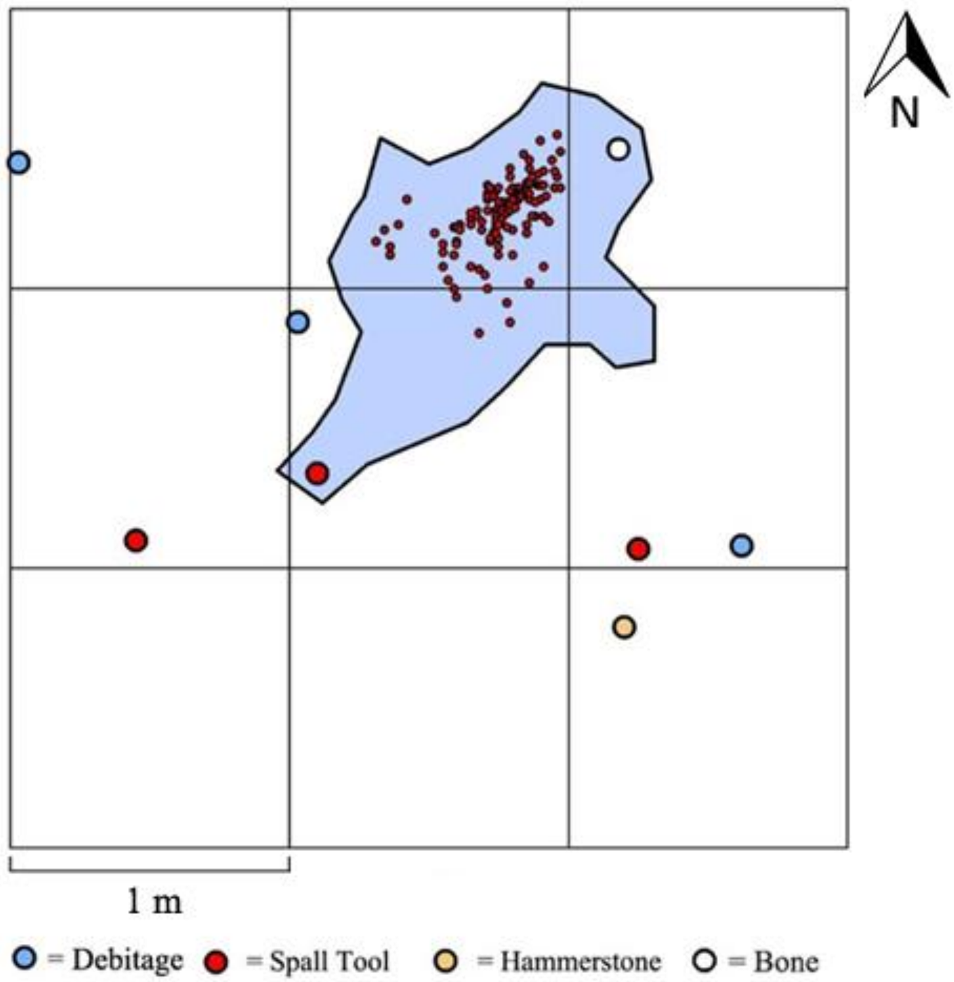


Figure 7.21 Distribution of artifacts greater then 5 cm in size, in relation to cluster MRC2.

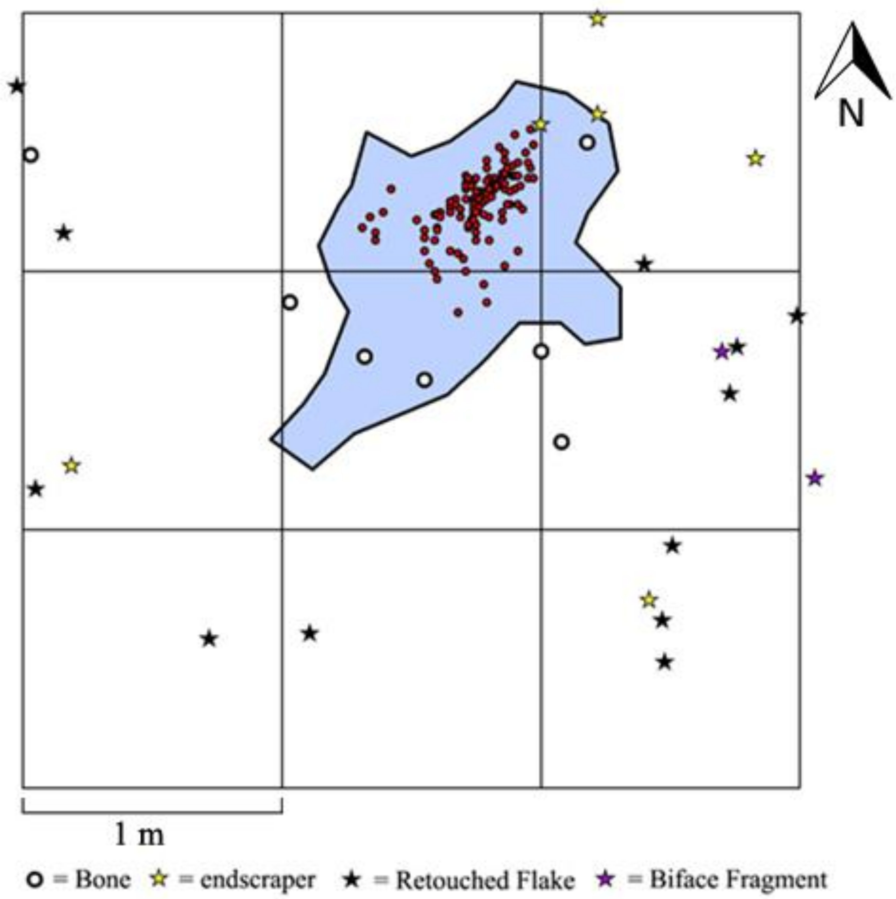


Figure 7.22 Distribution of tools in relation to cluster MRC2.

Evidence against cluster MRC2 as an invisible hearth feature is that many bone artifacts recovered from Block C appeared to be fairly recent in age, as they are larger and better preserved than most bones recovered in a boreal forest environment. Although cluster MRC2 corresponds with an area of the site where artifacts were recovered from deeper depths than the rest of the artifacts in the block (Section 6.4.1; Figure 6.21), bone artifacts were recovered from nearer to the surface. This could be an indication that bone artifacts surrounding cluster MRC2 are totally unrelated to the cluster and represent a more recent event.

It is possible that in more recent times a hunter butchered an animal at this spot and it just happened to occur in the same location where the artifacts in cluster MRC2 are located. At least one of the bone artifacts recovered from near the cluster contained possible cut marks, and there was little evidence on the artifact to suggest that it was burned (Figure 7.23). If the bone artifacts are unrelated to the cluster, then this weakens the hypothesis that cluster MRC2 is an invisible hearth feature. However, bone artifacts in the boreal forest typically do not preserve, so even if the bone artifacts surrounding the cluster are unrelated, it is possible that older pieces of bone connected with the cluster were present in the past but never preserved.

Figure 7.23 Evidence of cut marks seen on one of the pieces of bone located near cluster MRC2.

A second potential explanation for the cluster of heat-altered materials is that this area of the site was affected by a forest fire. The lithic debitage in cluster MRC2 may have been previously affected by bioturbation such as root growth, which would explain why the artifacts in this section of the site appear to be deeper than most other artifacts in the block. If the artifacts were clustered around the root of a tree and it caught fire, the root burn may have caused enough heat to leave the evidence of heat-alteration seen on the quartzite and salt and pepper quartzite artifacts. However, any heat-alteration of lithic materials due to a forest fire tends to be random or dispersed (Alperson-Afil et al. 2007), and the dense cluster of heated materials in cluster MRC2 suggests they were heated by something other than a forest fire. Additionally, although a high amount of heat-altered quartzite was recovered from the site, there are very few clusters containing a large quantity of densely compact heat-altered materials such as the one seen in cluster MRC2.

The artifacts contained in cluster MRC2 suggest numerous activities. The spall tool could have been used for scraping or softening a hide, or it may have been used to break open a bone of an animal that was being butchered. The endscrapers also suggest hide work, but also could have been used for wood work such as scraping tinder off a stick for a fire. Additionally, the large quantity of debitage including decortification flakes suggest this was an area of stone tool manufacture.

7.6.3 Cluster MRC3

Cluster MRC3 is a small cluster of 20 artifacts made of quartzite and grey chert. All the quartzite artifacts contained in the cluster consist of decortification flakes, which indicates a quartzite core was reduced here. However, no core was recovered from close to where the cluster is located. It is possible that a quartzite cobble was collected from the nearby stream and the decortification flakes were removed in order to assess the material quality and reduce the weight of the core before it was carried off the site. A single biface fragment made from quartzite was located next to the cluster and could be associated with the quartzite artifacts. The biface was broken and likely discarded during manufacture. The grey chert artifacts consist of one endscraper, one split pebble, a bifacial reduction flake, and three flake fragments. Although the quartzite and grey chert artifacts are contained in the same cluster, it is possible that they are completely unrelated. Quartzite artifacts are all contained in the western half of the cluster and grey chert artifacts are in the eastern half (Figure 7.24).

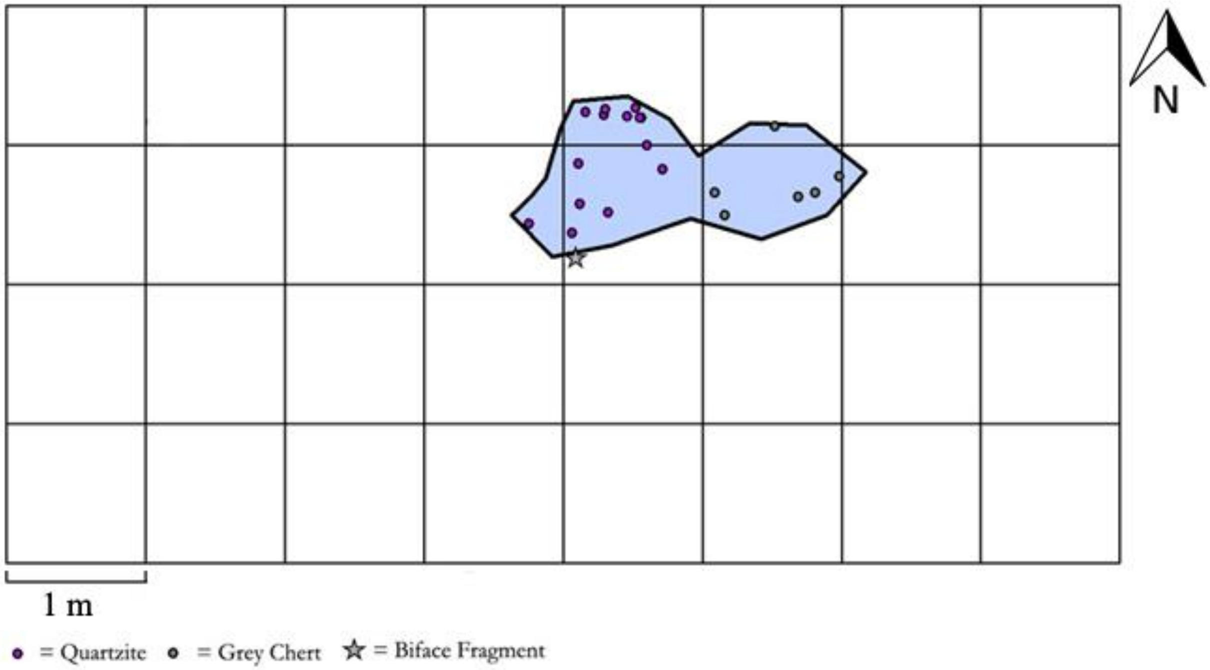


Figure 7.24 Distribution of artifacts by raw material type in cluster MRC3. A single biface face fragment made of quartzite was also located next to the cluster and could be related to the quartzite artifacts.

7.6.4 Cluster MRC4

Cluster MRC4 is a small cluster of 35 artifacts made up mostly of quartzite debitage. Two flake fragments of grey chert are included in the cluster, but spatially they appear to be related to the grey chert artifacts from cluster MRC3 (Figure 7.25). These artifacts may have been included in cluster MRC4 due to issues with the k-means algorithm (Chapter 5, Section 5.3.5.4). The quartzite artifacts include one core, three decortification flakes, two pieces of shatter, and 26 flake fragments. Several quartzite retouched flakes surround the quartzite artifacts and could be associated to the artifacts in cluster MRC4 (Figure 7.25). However, many quartzite artifacts were recovered from Block C, so it is hard to make this assumption with certainty. The artifacts contained in cluster MRC4 suggest it was an area of lithic reduction where a core was reduced.

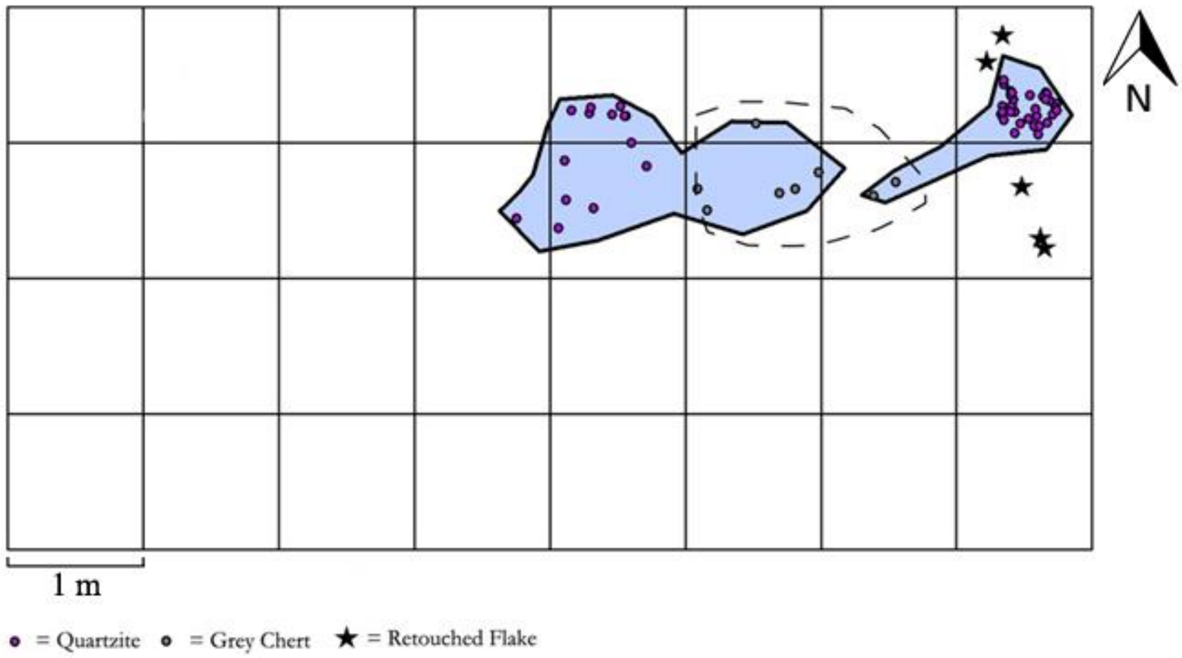


Figure 7.25 Distribution of quartzite and grey chert artifacts in clusters MRC3 and MRC4. The grey chert artifacts appear to be spatially related to one another (indicated by the dotted line).

7.6.5 Cluster MRC5

Cluster MRC5 contains 33 artifacts made of quartzite, Peace Point Chert, BRS, grey chert, white chert and salt and pepper quartzite. Tools in the cluster include one endscraper, one spall tool, two utilized flakes, and two retouched flakes. Debitage includes flake fragments, decortification flakes, shatter, and bifacial reduction flakes.

Cluster MRC5 is located just south of cluster MRC1 and the cluster composition of both the are similar. Both clusters contain similar raw material types and contain similar artifacts. Spall tools and retouched and utilized flakes are contained in both clusters. Evidence of lithic reduction and manufacture can be seen in both clusters in the form of cores, decortification flakes, flake fragments, and bifacial reduction flakes. On the other hand, the spall tools and endscrapers are evidence of activities such as processing a hide. The similarity between the two clusters could mean that they are related, or it could mean that artifact mixing occurred between the two clusters and they represent two separate activity areas from multiple occupations.

7.6.6 Cluster MRC6

Cluster MRC6 is a very small cluster containing only grey chert artifacts. One utilized flake is contained in the cluster and the debitage consists of shatter and two decortification flakes. No tools surround the cluster, and no grey chert cores were found in Block C. The decortification flakes could be evidence of a flintknapper testing a grey chert core before taking it away.

7.6.7 Cluster MRC7

Cluster MRC7 contains 91 artifacts made of various lithic material types including quartzite, BRS, argillite, Peace Point Chert, and grey chert. One retouched flake of Peace Point Chert is contained in the cluster, which is otherwise made up of debitage including bifacial reduction flakes, flake fragments, re-sharpening flakes and a single decortification flake. The debitage suggests this was an area of lithic manufacture where tools were created and finished. The general lack of tools in this area could be because they were carried away; however, since the cluster is located next to the edge of the excavation block, it is possible that any broken or discarded tools could exist in the unexcavated area of the site. The large quantity of bifacial reduction flakes could indicate that bifaces were manufactured here for the purpose of transporting the raw material or having cutting implements on hand for activities such as hide working, food preparation, or to work wood, antler or bone.

7.6.8 Cluster MRC8

Cluster MRC8 is located directly south of cluster MRC7, and both are made up of similar artifact types and raw materials. The artifacts from cluster MRC8 are made up of quartzite, BRS, black chert, and Peace Point Chert. No tools are contained in cluster MRC8, which is made up of flake fragments, shatter, re-sharpening flakes, decortification flakes, and bifacial reduction flakes. The general make-up of artifacts suggests this was an area of lithic manufacture. Furthermore, since the artifacts are similar to those contained in cluster MRC7 and the two clusters located close together there is a high probability that these two clusters are related.

Both clusters contain BRS and Peace Point Chert artifacts which would have had to have been carried into the site from afar. The large quantity of lithic debitage of various raw material types and the general lack of tools could be an indication that the artifacts in clusters MRC7 and MRC8 represent an area of the site where lithic materials were discarded by a flintknapper who was working a variety of material types and collecting the debitage on a mat or skin. The possibility also exists that multiple occupations overlapped in this area, but the general make-up of debitage collected is similar and suggests a single episode of tool manufacture.

7.6.9 Block C Summary

A total of eight clusters were identified in Block C. The clusters identified in Block C allowed for a range of activities to be postulated, and at least one potential feature to be identified. However, at least one of the clusters, MRC6, only contained five artifacts. This cluster may only be valid from a statistical perspective, but whether it reflects a culturally derived cluster is questionable. Cluster overlap or mixing was likely to have occurred in Block C; however, despite this the statistical techniques employed allowed for a better understanding of the activities that took place in this area of the site.

7.7 Block D

Block D is an area of low artifact density, containing only 535 artifacts, with 345 of those artifacts coming from one unit. Ives returned to the site in 1980 to further excavate this area in hopes of finding a diagnostic artifact, and although no diagnostic artifacts were recovered, he collected additional artifacts, bringing the total to over 400 items (Ives 2017:312). Unfortunately, the catalogue of the additional excavation was not available for this study. Despite Block D's relatively small artifact assemblage, it contained a high proportion of tools and large pieces of debitage. Three horizontal clusters were defined in Block D, which are similar to the results produced by Ives (1985)

7.7.1 Cluster MRD1

Cluster MRD1 corresponds with an area of high artifact density in Block D and contains a total of 291 artifacts. A variety of lithic materials are contained in the cluster including quartzite, BRS, black chert, argillite, grey chert, yellow chert, white chert, salt and pepper quartzite, and Peace Point Chert. Cluster MRD1 contains the highest number of tools of all the clusters defined at the site, incorporating nine endscrapers, 29 utilized flakes, 22 retouched flakes, three unifaces, two sidescrapers and one biface. Numerous flake fragments, decortification flakes and six split pebbles are also contained in the cluster.

Cluster MRD1 corresponds to a large cluster of artifacts defined by Ives (1985), cluster D2, and shares a similar tool composition. Ives (2017) returned to the site in 1980 and that excavation recovered more tools that Ives believes should be added to the cluster's composition. With the results of both Ives' excavations, the tools in this cluster consist of 51 retouched flakes, seven split pebbles, nine endscrapers, four unifaces, three bifaces, two cores, and two sidescrapers (Ives 2017:313). The proportion of tools is significantly high, even when compared to the artifact assemblage of higher density blocks such as Block A and C.

Stevenson (1986) suggested that the cluster was a storage area where artifacts were assembled and then stored prior to leaving the site. However, as Ives (2017:314) points out nearly every piece in the cluster is "marked by unusual wear and abrasion, affecting not merely artifact edges but flake arrises as well." Ives suggests that the cluster represents the contents of a container that was used to transport the artifacts over some distance, giving the artifacts the opportunity to rub against each other. The container was then left, or the contents spilled out in the Block D area. The cluster is made up of approximately 21 percent BRS materials and these would have had to have been carried into the site from the Athabasca oil sands region. Cluster MRD1 also contains a large percentage of both large and medium sized artifacts when compared to all other clusters defined in the Eaglenest Portage assemblage. Larger materials would be more likely to be transported or carried away in a storage container. Large items also might be included in a toss zone or refuse pile; however, the high number of tools which were not at the end of their use life is indicative of the fact that this is probably not the case.

7.7.2 Cluster MRD2

Cluster MRD2 contains 21 artifacts of quartzite and salt and pepper quartzite. All the artifacts in the cluster have evidence of heat-alteration. The cluster includes flake fragments and a single decortification flake. This cluster also corresponds with the approximate location of one of the clusters defined by Ives, cluster D3. Artifacts included in cluster D3 consist of one utilized flake, four retouched flakes, and one biface. Figure 7.26 shows the distribution of artifacts in Ives' cluster compared to where cluster MRD2 was located. All the artifacts in Ives cluster are made of quartzite, except for one retouched flake which was made of salt and pepper quartzite. However, none of the tools in Ives cluster show evidence of heat-alteration while all the artifacts in cluster MRD2 do. Despite the lack of heat-alteration the artifacts may be related as there were very few artifacts in this section of the block and the raw materials are consistent with the artifacts in the MRD2 cluster. Furthermore, not all material in a heat-altered nodule or cobble will always show clear evidence of heat-alteration, depending on where it was heated on the piece of stone and for how long it was heated.

Not including the artifacts contained in Ives' cluster, cluster MRD2 contains 100 percent heat-altered materials. Given the high density of heat-altered materials a hypothesis could be made that it represents an invisible hearth feature. However, only 21 artifacts were included in the cluster. Additionally, the heated materials in the cluster tend to be more dispersed when compared to other potential hearth features at the site such as clusters MRA5 and MRC2 (Figure 7.27). Waguespack and Surovell (2014:39) have hypothesized that areas of a site that contain a low density of artifacts, but a high percentage of which are heated, may be indicative of areas in which cleaning and dumping of hearth contents occurred. This is a possibility with the heat-altered materials in cluster MRD2, but it also could just be an area of lithic reduction where a heat-altered core was reduced.

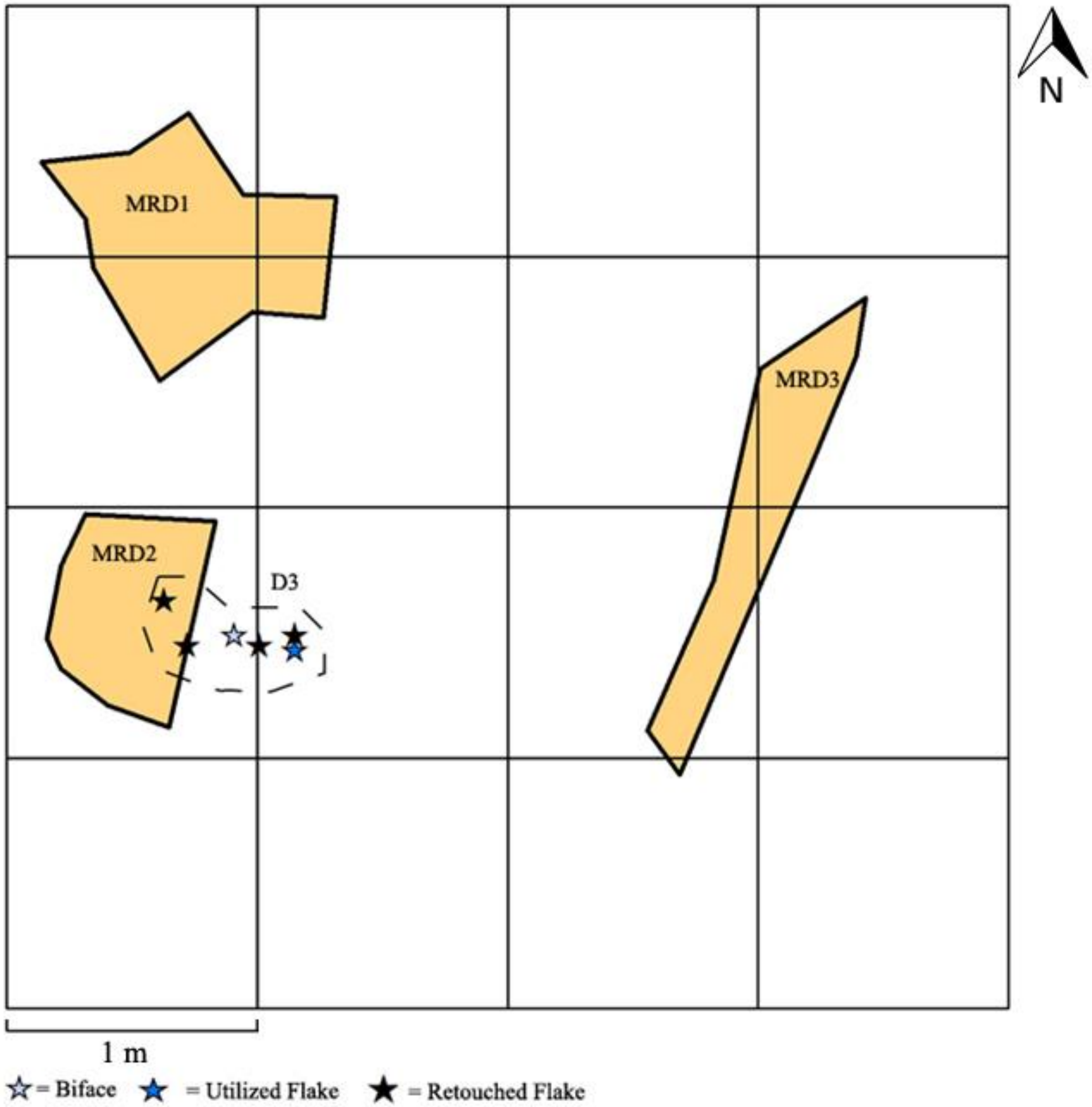


Figure 7.26 Distribution of artifacts contained in Ives cluster, D3 (indicated by the dotted line) compared to the location of cluster MRD2.

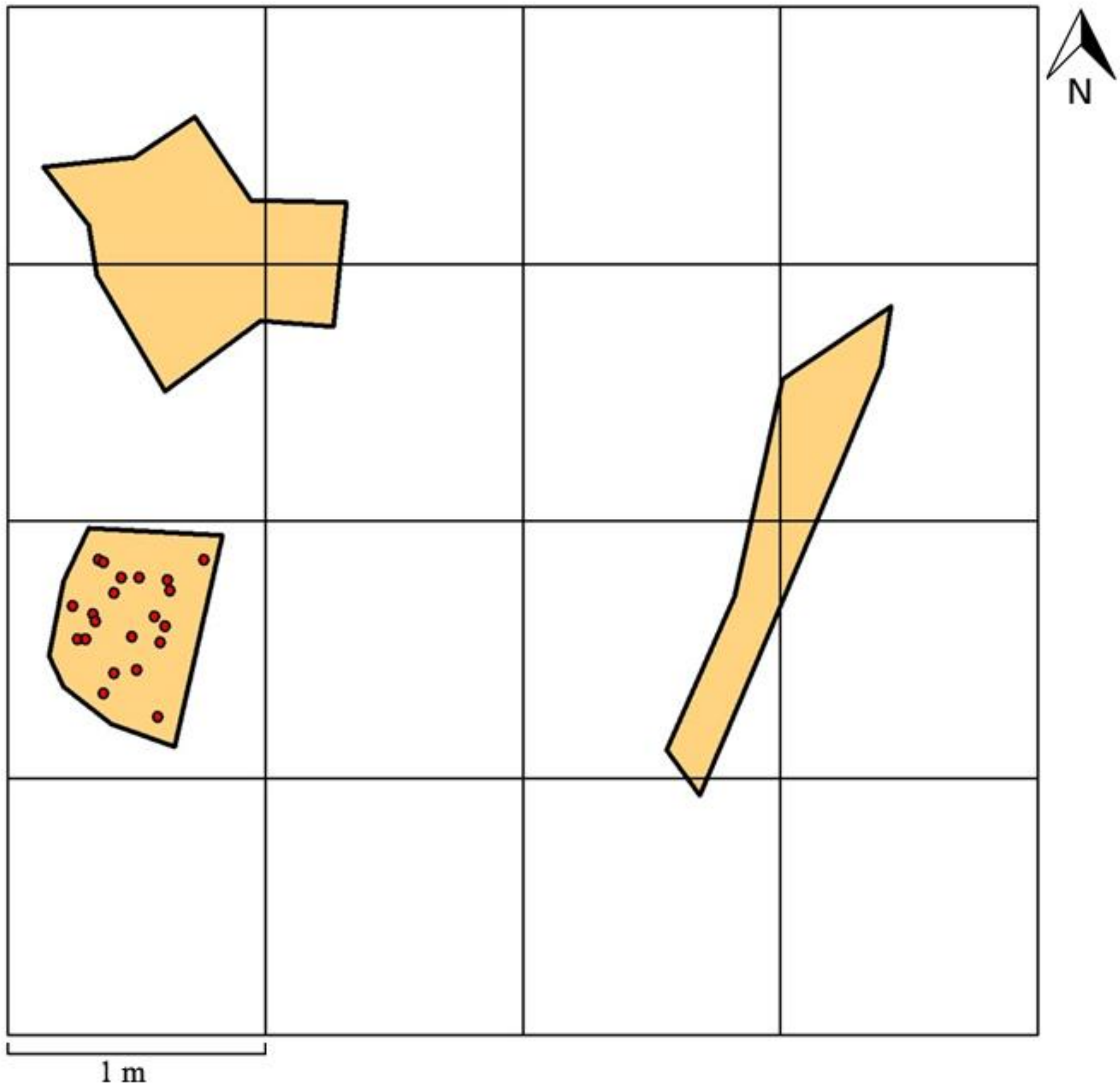


Figure 7.27 Distribution of heat-altered materials in cluster MRD2.

7.7.3 Cluster MRD3

Cluster MRD3 is a very small cluster containing only four artifacts, all manufactured out of coarse grained quartzite. Two spall tools, one flake fragment and one piece of block shatter are included in the cluster. The artifacts in the cluster are widely dispersed, with the two spall tools located approximately 1.4 m away from each other (Figure 7.28). Despite this, these are the only coarse-grained quartzite artifacts contained in Block D. The similarity of the raw material type and that both are spall tools suggest they may be related. There are very few tools in this cluster, which makes any meaningful functional interpretations difficult, but the spall tools could have been used for chopping or for hide work. However, given the scarcity of items contained within this cluster and the fact that they are not close together, it is possible that this is a cluster from a statistical perspective and not a culturally derived cluster.

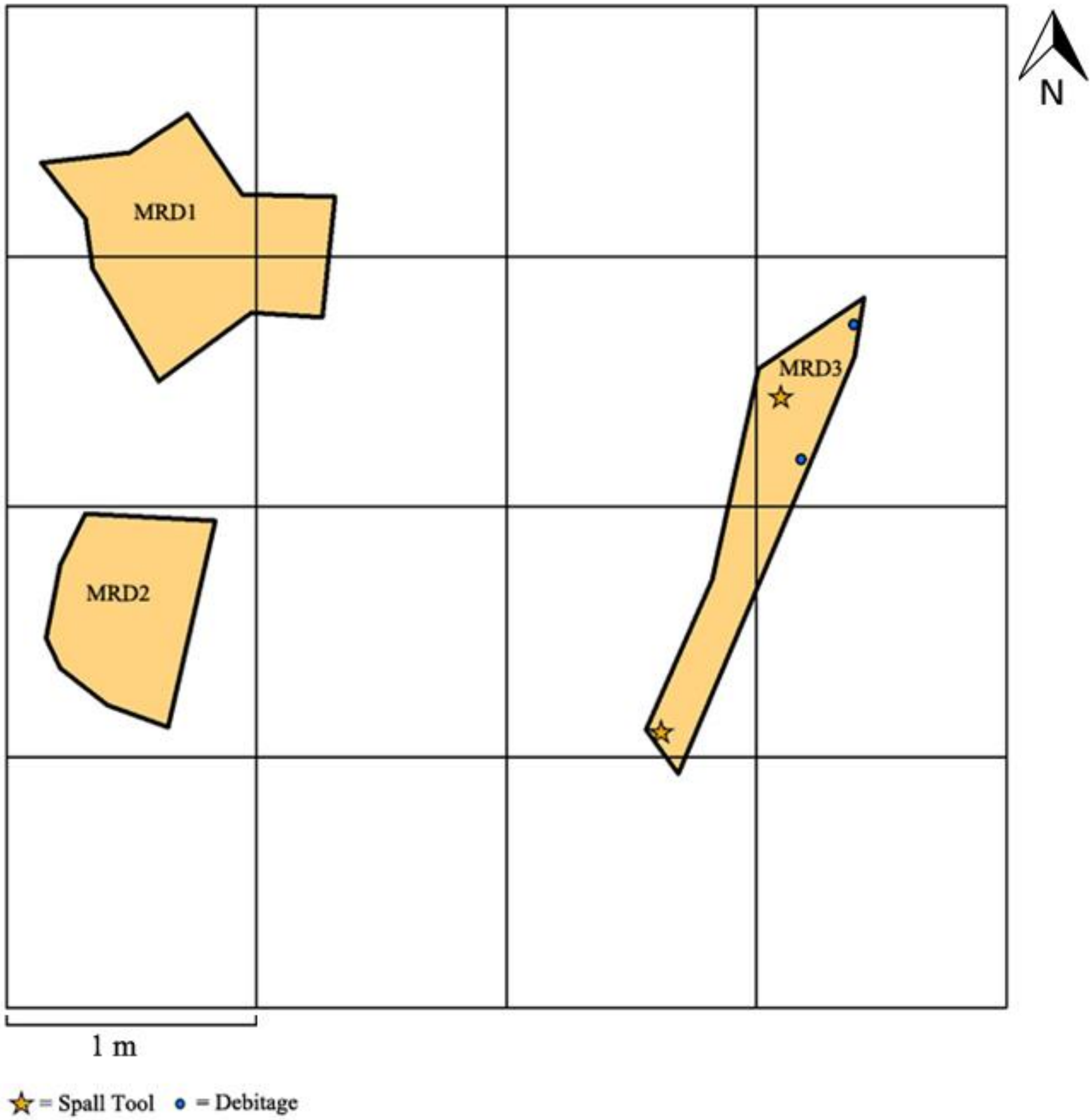


Figure 7.28 Distribution of artifacts in cluster MRD3.

Cluster MRD3 is located just south of a cluster defined by Ives, cluster D1, which contains two utilized flakes, three retouched flakes, one split pebble, and one core (Figure 7.29).

The artifacts in Ives' cluster contains quartz, grey chert, black chert, and quartzite artifacts. There are no indications that cluster D1 is related to any of the clusters identified in this study.

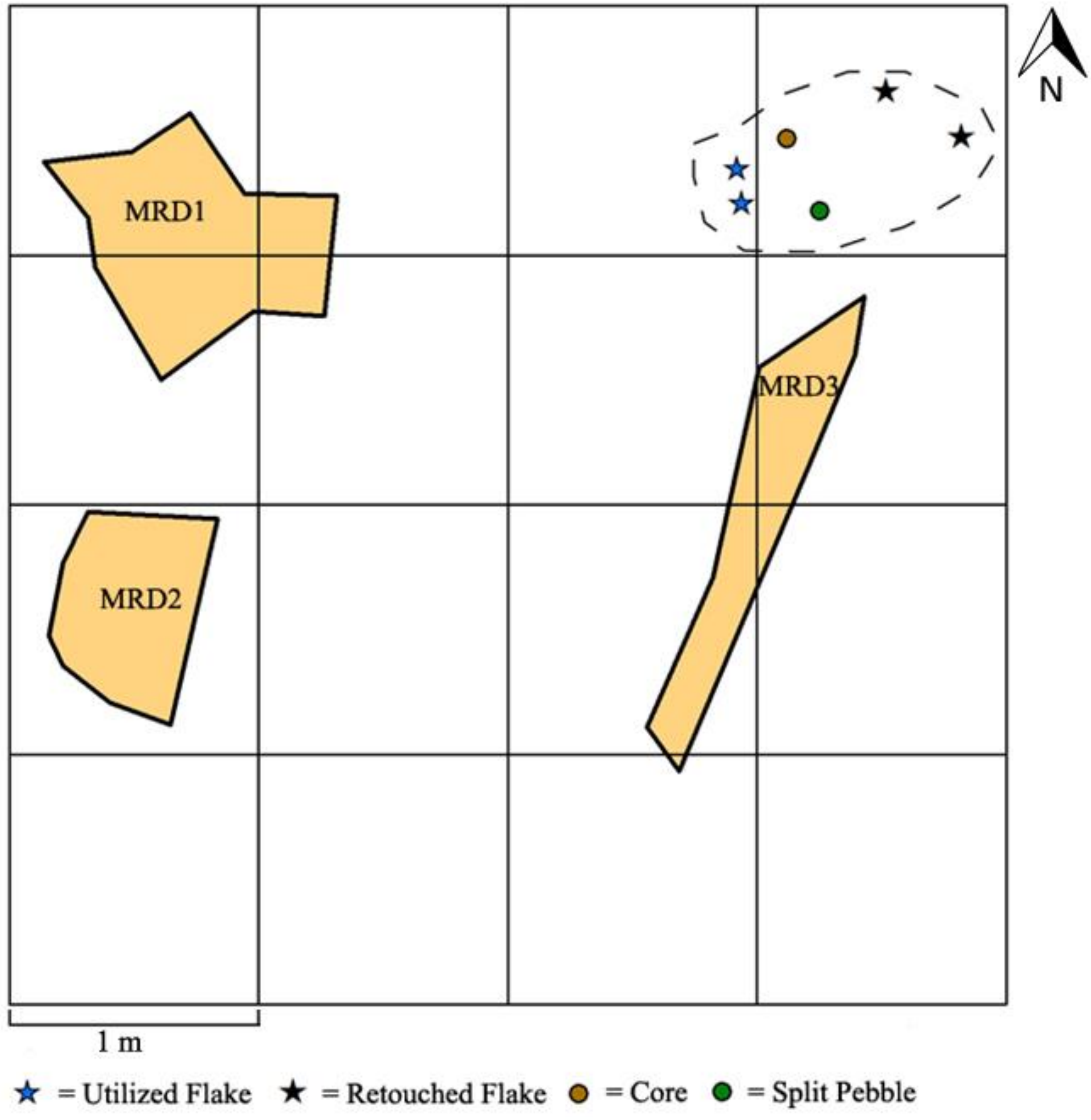


Figure 7.29 Cluster identified by Ives (indicated by the dotted lines) in relation to the clusters MRD1, MRD2 and MRD3.

7.7.4 Block D Summary

A total of three clusters were identified in Block D. Although two of the clusters appear to be culturally significant, the third cluster, cluster MRD3, may be a cluster only in the statistical sense, due to the small number of artifacts that are widely dispersed away from one another. The large number of tools contained in cluster MRD1 is consistent with the cluster D2 identified by Ives and may be evidence of a bag or storage container that was abandoned. Despite containing 100 percent heat-altered materials, cluster MRD2 does not appear to be a phantom hearth feature and instead may represent an area where a heat-altered core or tool was reduced. The fact that cluster MRD2 overlaps with cluster D3, could indicate that it was an area where a heat-altered core was reduced to replace the tools left behind in cluster D3. Cluster overlap or mixing is a distinct possibility; however the low number of artifacts suggest that the artifacts likely represent a single event.

7.8 Conclusion

The methods employed in this study allowed for a number of quantitively derived clusters of varying types to be identified, many of which allowed for archaeological interpretations, including the interpretation of potential activity areas and features. What made this possible was a reliance on spatial analysis and the three-point provenience of all artifacts recovered from the site. An assessment of the methods used in this study as well as the validity of clusters will be discussed in greater detail in Chapter 8.

CHAPTER 8: CONCLUSION

8.1 Introduction

The research presented in this thesis has shown that carefully controlled excavations, with an emphasis on three-point provenience measurements and spatial analysis, offer an objective method by which to deal with some of the spatial concerns seen at sites in the boreal forest. Although different methods were used, many of the clusters determined through this study coincide with the clusters identified by Ives (1985). However, in some cases the results were quite a bit different. This signifies the changing horizon for what statistical techniques can accomplish, and undoubtedly these kinds of techniques will continue to advance in the future. As statistical methods continue to improve, so too should our excavation procedures. In this way, archaeologists who wish to tackle the spatial issues seen in the region will stand a better chance at improving our understanding of the pre-contact groups that inhabited the boreal forest.

8.2 Summary

Excavations at the Eaglenest Portage site yielded artifacts of high interpretive value. However, due to the poor organic preservation, many indicators of cultural activity are minimally present to nonexistent. Very minimal amounts of bone were recovered from Blocks A, B, and C, and no bone was recovered from Block D. Despite this, activity areas were inferred from the stone tools and debitage that had been left behind. The kinds of interpretations that were made would have been much more difficult, if not impossible, without the use of three-point provenience data and spatial analysis.

Some evidence of patterning in the vertical distribution of artifacts was noted in Blocks A, B and C. In Block A, Beaver River Sandstone (BRS) and micro debitage were only found below 15 cmbd. It is often assumed that larger artifacts are more prone to downward displacement through activities such as burrowing (Wood and Johnson 1978); however, most large artifacts from the Eaglenest Portage site showed no patterning in their vertical distribution. Most of the BRS artifacts in Block A were microdebitage, and it is possible that some sort of bioturbation was responsible for the pattern seen in their vertical provenience. Armour-Chelu and Andrews (1994) noted in their study that earthworms were more likely to vertically displace small pieces of bone than larger ones. Although worms are unlikely to have vertically displaced artifacts at the Eaglenest Portage site, smaller animals such as frogs may have caused a similar vertical displacement of BRS artifacts recovered from Block A.

Historic materials, green chert, and bone artifacts in Block A were all recovered from above 19 cmbd. Consequently, these artifacts may be younger than the rest of the artifacts recovered from the Block, and, if so, it could be hypothesized that there was less chance for them to become vertically displaced. Grey chert found in association with green chert artifacts in cluster MRA2 was found at a similar vertical provenience, despite the fact that grey chert artifacts were recovered from various depths throughout the block, therefore the grey chert artifacts in this cluster may also be associated with a younger age. This could mean that grey chert was used in both earlier and later occupations of the block; however, the grey chert materials included in cluster MRA2 were more recent and therefore did not get bioturbated to greater depths.

In Block B various artifacts were associated with particular depths. For instance, bone, salt and pepper quartzite, quartz artifacts, and bifaces were only found below 20 cm, whereas split pebble artifacts were only found between 7 to 14 cm. However, this could easily be explained by the fact that these categories all contained very few artifacts and the small artifact count skewed their representation in terms of depth values. Consequently, it would be premature to assign any chronological relationship to these depth associations.

Bone artifacts from Block C were only found above 20 cm and based on their level of preservation they appeared to be fairly recent in age. This makes the association of the bone artifacts with the potential hearth feature in cluster MRC2 debateable. The bone appears to be relatively recent, and the rest of the artifacts in the cluster are dispersed in their vertical provenience at depths much deeper than the bone (Figure 8.1). However, assuming the rest of the artifacts in the cluster are temporally related, it shows how much vertical displacement can occur. The shape of the artifacts within the cluster resemble wedge shaped features discovered at the Quarry of the Ancestors which have been interpreted as ice wedge casts (Woywitka 2018:43). A difference of around 30 cm occurs between artifacts at the top of the cluster and artifacts at the very bottom of the cluster. The lithic artifacts were likely deposited contemporaneously, and the vertical displacement could be the result of artifacts slumping into the fill as the ice began to melt. Without the use of three-point provenience data and spatial statistics, it is unlikely that the temporal relationship between these artifacts would have been recognized.

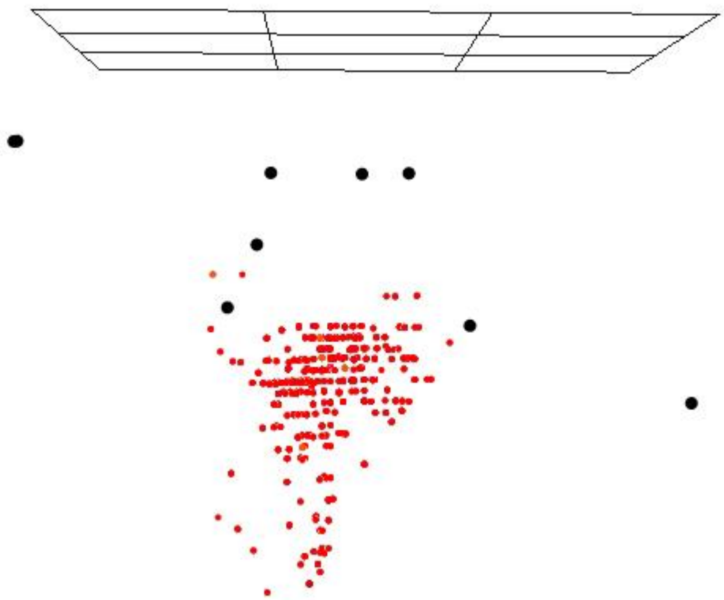


Figure 8.1 Distribution of bone artifacts in relation to Cluster MRC2.

Many of the tools recovered from the Eaglenest Portage site were utilized and retouched flakes. Many projectile points were recovered from the site; however, only three clusters were associated with any diagnostic points. The three projectile points recovered in cluster MRB1 are all similar in style which suggests they are contemporaneous. The projectile point in cluster MRB3 could represent a very early occupation of the site, if it is related to the Component II material recovered from Dry Creek, Alaska. Surprisingly, very few bifaces were recovered from the Eaglenest Portage site, and most of those were fragmentary. As documented above (Chapter 7, Sections 7.6.1, 7.6.3 and 7.6.7) evidence exists that biface production and tool manufacturing took place at the site, and it is possible that more bifaces occur in the unexcavated areas of the site or they may have been curated for future use. One possibility to account for the lack of bifaces is the act of retooling; that is the process of replacing exhausted or broken tools with new ones. A scenario of this sort could account for clusters such as MRC7 in which a large amount of bifacial reduction flakes was recovered in the absence of any tools.

This study identified a number of clusters in each of the blocks excavated at the Eaglenest Portage site. The methods used for this study relied on a number of statistical techniques that worked well, especially when used in conjunction with one another. However, some of the clusters were small and may only be clusters in a statistical sense, such as clusters

MRA8, MRB4, MRC6 and MRD3. The small number of artifacts contained in each of these clusters could mean that they are more a product of quantitative error arising from forcing cluster formation in spite of few artifacts being present.

In some cases, cluster overlap was strongly suspected, such as in clusters MRA6 and cluster MRA7, and in clusters MRC7 and MRC8. Incidences of cluster overlap were more apparent in Block A and C where artifact densities were the greatest. From this perspective, a more informed mitigation strategy would be to excavate moderate density areas such as Block B where cluster overlap was less likely to have occurred (see also Ives 1985).

It should be noted that in some cases, clusters may have been altered or created through bioturbation. For example, artifacts caught in a root plate that deteriorates can become piled up in a tight distribution beneath where the root disc rests on the ground. For this reason, a stronger argument can be made regarding artifacts that are of a similar type and raw material as being culturally related if they are within the same cluster.

Numerous clusters were identified through this study that offer more penetrating archaeological interpretations, including the recognition of potential features such as in clusters MRA5 and MRC2. While a forest fire could account for the high number of heat-altered items in an archaeological assemblage, this is likely not the case when heat-treated artifacts are located in a dense cluster. However, as evidenced by cluster MRD2, heated materials do not necessarily indicate the presence of a former hearth. In these instances, working of a heat-altered core, or the cleaning and dumping of hearth contents seems more likely. For this reason, it is important to pay close attention to the artifacts, both within and around any potential invisible hearth features, to better ascertain whether or not a now invisible hearth was once present.

8.3 Recommendations

Based on the results of this thesis project, a number of future directions can be advised. As Woywitka (2018:93) points out, the current approach to archaeological work in the oil sands region has been largely reactive, especially during times of economic booms. The result is that archaeologists who work in the region often tend to excavate by chasing high densities of artifacts, rather than excavating with an informed purpose and with specific research questions in mind. However, a stronger strategy may be to collect artifacts with the associated three-point provenience data from areas of a site where there is only a moderate density of artifacts. Larger excavation blocks using the conventional cultural resource management methods could be reserved for areas of a site where there are a higher density of artifacts and where the piece plotting of artifacts may be a more daunting task (see also Roskowski 2015:251-252). Ives' (1985) use of transects prior to excavation allowed for the identification of areas that were more likely to be of high, moderate, and low density and this strategy could be used today to help inform archaeologists of where to excavate.

Unfortunately, many of the spatial clusters defined in the Eaglenest Portage assemblage lack chronologically diagnostic artifacts. However, cluster MRB1 contains three projectile points, that based on stylistic comparisons are arguably contemporaneous with each other (Chapter 7, Figure 7.12) and cluster MRB3 contains a diagnostic point that could be as old as 10,000 B.P. (Chapter 7, Figure 7.13). The globular impurities in the quartzite contained in cluster MRB3 offer a line of evidence that these artifacts are temporally related. If more sites were to be excavated in this manner, the ability to tag artifact clusters with potentially diagnostic artifacts or the ability to identify clusters that contain material that is able to be radiocarbon dated will become more frequent. This will leave researchers with an objective basis to determine if the artifacts are temporally related and will eventually greatly enhance our understanding of the pre-contact people who inhabited the region.

This study would have been greatly enhanced by a detailed refit analysis of the Eaglenest Portage assemblage. Artifacts that refit together conclusively document temporal affinity. Therefore, a spatial study that incorporates a detailed refit analysis would greatly enhance the interpretation of sites in the boreal forest.

It is often assumed that heat-altered materials recovered in the boreal forest could be the result of a forest fire. Furthermore, when artifacts are catalogued, evidence of heat-alteration go unrecorded. However, as this study shows dense clusters of heat-altered materials could be an indication of a previous hearth feature. So another recommendation would be to pay close attention to heat-altered materials recovered from a site, especially when it is found in relation to bone or fire broken rock.

8.4 Conclusion

The Eaglenest Portage site represents one of the few sites in northern Alberta where three-point provenience data has been recorded for nearly all artifacts collected. This has greatly enhanced the interpretability of the site and allowed for a more detailed spatial analysis. As archaeologists we typically assume that the data we collect and the manner in which we collect it will be relevant and adequate for future research. However, a study of this nature would have been impossible with a dataset collected through cultural resource management, at least as it is typically practised. Numerous studies have emphasized the importance of three-point provenience data in the interpretation of sites with limited stratigraphy (Ives 1985, Pyszczyk 1981, McCulloch 2015, Rawluk et al 2010), with this in mind, archaeologists and archaeological regulatory bodies should rethink what is deemed to be adequate excavation practices in the boreal forest.

While it is true that the methods recommended through this study are more time consuming than the excavation of sites without piece plotting, the detail of the information collected is greatly increased. Therefore, it is recommended that we make strategic trade-offs when faced with the excavation of sites that are rich in artifacts but poorly stratified. One method would be to follow Ives' (1985) example of digging transects prior to mitigation to identify areas of a site where the piece plotting of artifacts would be the most beneficial. It is possible to keep the net cost of a large mitigation about the same as it is today if we agreed to reduce the number of excavation units we open at the site. For example, if we were faced with a site that would require 200 m^2 of excavation using the traditional cultural resource management methods, we could instead choose to excavate half that amount. While we would be excavating less of the site, we would be doing so with a much greater detailed recording of the artifact spatial data increasing the interpretive potential of the excavation. Furthermore, the data we collect would be available well into the future and would allow for a more detailed analysis as new techniques develop. For instance, the data used for this research was collected over 40 years ago and it was still able to be used to make detailed interpretations of the Eaglenest Portage site. If policy changes were made to allow for smaller excavations with a higher quality of data collected, this would provide an advantage to researchers versed in spatial statistics who wish to use the data to improve our knowledge of the boreal forest region.

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